THE LONDON NATURALIST

the journal of the
LONDON NATURAL HISTORY SOCIETY

No 62

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LONDON NATURAL HISTORY SOCIETY

The Society welcomes new members both beginners and experts. Its Area lies within a 20-mile (32 km) radius of St Paul's Cathedral and here most of its activities take place. Although much is covered with bricks and mortar, it is an exciting region with an astonishing variety of flora and fauna. The Society comprises sections whose meetings are open to all members without formality. For those interested in arachnology, archaeology, botany, conchology, conservation, ecology, entomology, geology, herpetology, mammalogy, ornithology or rambling, there is a section ready to help.

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Report of the Society for 1982*

The Society has had an active year. The most important change has been the winding-up of the L.N.C.C. following the formation of the London Wildlife Trust, which will be able to play a larger role in conservation in the Greater London area. So that close links with the Trust can be maintained, the Society is represented on the Trust's Conservation Committee and has also made a grant of £500 towards the first year's salary of the Trust's full-time Conservation Officer.

The programme continues to be full and varied, with both formal lectures and informal talks almost every week and outdoor meetings most weekends. Unfortunately attendance at some indoor meetings has been poor, perhaps because of transport difficulties. However, attendance at the Bookham Common meetings has improved significantly. We thank all those who have arranged these meetings and especially Richard Butler and Keith Hyatt who have seen to the programme in the absence of a programme secretary. Mrs New and Mrs de Quidt will now look after the programme and Miss Rosalind Hadden has taken over as editor of the *Newsletter*.

The Society has also been active on other fronts. The Bookham Common surveys continue and work on the plant atlas is now reaching its final stages. In recognition of his many years' work for Bookham Common, Dr Geoffrey Beven was created an Honorary Vice-President of the Society. The South-West Middlesex Section took part in a survey of Hounslow Heath in conjunction with the L.W.T. and also undertook a survey of the Churchyard of St Leonard's, Cranford. The Society also organised stands at a number of exhibitions during the year.

The number of members is virtually unchanged this year, which is an improvement compared with the two previous years. The figures are as follows:

	1982	*1981*
Ordinary	877	*891*
Affiliated	22	*24*
Family	114	*103*
Junior	26	*29*
Senior	79	*74*
Honorary	17	*16*
Life	8	*9*
Total	1,143	*1,146*

We learn, with regret, of the deaths of the following seven members: T. G. Collett, Miss V. M. Gotch, J. H. Ludford, H. W. Payton, C. W. G. Paulson-Ellis, Miss C. M. Swinburn and H. T. M. Wilson.

Our thanks, as ever, go to Imperial College for the use of their rooms for Committee meetings and to Mr Whitworth and his staff for custody of the Society's library.

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*Presented at the Annual General Meeting, 9 December 1982.

The Function of a Local Natural History Society

by R. M. BURTON

(Presidential Address delivered at the Annual General Meeting on 9 December, 1982)

Looking back over my term as President of the London Natural History Society, in search of a subject suitable for my parting address to you, I noticed how the crux of the argument within the Society generated by the establishment of the London Wildlife Trust, undoubtedly the major event in our history of those two years, was whether we should encourage the establishment of a body whose function would not apparently be very different from our own. It seemed to me that an examination of our own function would be timely, and might produce notions which could be of interest to officers of other societies like ours who will eventually have the opportunity to read this when it has been printed in *The London Naturalist.*

I do not think it is sufficient simply to state that the Society should do whatever its members want it to. The wishes of the members at large are hard to ascertain and in any case probably conflict with each other. What we must not forget is that the Society is financed by their subscriptions. In our case the bulk of their money is spent on printing two annual journals. At a time when such a large proportion of their names turn up in the lists of bird sightings it seems right that there should be a separate *London Bird Report*, with *The London Naturalist* catering for other branches of natural history. I would not care to continue this argument by saying that the contents of *The London Naturalist* should mirror exactly the spread of members' interests. A better editorial policy would be to seek to enlarge them. For instance we have very few conchologists in our number, but an article reporting on a study of the ecological relationships of a snail which is particularly well represented in our area would be well placed in our journal, whether or not it was written by one of our members.

Such a policy would be in accord with our stated aim of publishing instructive material in matters of natural history. At this point I must distinguish between aim and function. Our objects are formally expressed at the beginning of the rules, in words which should satisfy the Charity Commissioners that we deserve the advantages of charitable status. Our functions are less fixed and more complex, as they include the means by which we try to achieve these objects. However, the aims of the Society are a good starting point for an exploration of its functions. Let me remind you of them. 'Its objects shall be the study of natural history, archaeology and kindred subjects especially within twenty miles of St Paul's Cathedral, the promotion of scientific investigations, nature conservation and the publication in the Society's journals of scientific and educational papers relating particularly to the Society's area.' I have already mentioned the journals at the end of that, and the study at the beginning should be self-evident, so I will concentrate on the central area, the promotion of scientific investigations and nature conservation.

In eighteen years as a member of the London Natural History Society I cannot remember that it consciously promoted any scientific investigations. In fairness to some of my presidential predecessors I should add that this was not altogether for want of trying. Mr Hyatt will recall the long discussions which took place in and out of Council tending to the establishment of a research committee with the power to allocate funds. I do not think any claims were ever made on the Society's funds as a result. Probably the promotion of scientific investigations has been among our stated objects since they were first formulated. In the meantime the Universities and the Polytechnics have developed biological studies using resources which an amateur body like ourselves can never hope to match. I would guess that if the Society ever does expand its own activities as a sponsor of investigative research, it will be in a collaborative venture involving a university department.

Our history as a promoter of nature conservation is very different. In the 1940s we set up a conservation committee which listed all the sites in the area deemed worthy of protection. This list is the basis of the schedule of sites of special scientific interest near London as it stood until very recently. That sort of work is done these days by the naturalists' trusts, but we started it before any of them were formed. The trusts have grown up on a county by county base reflected in their names. It is hard to remember how small the county of London was all through the '40s and '50s, when there was still a county of Middlesex. I think only one of the SSSIs just mentioned was geographically in London at the time. The re-drawing of boundaries in the mid-60s imposed on the nature conservation scene adjustments which are still not completed. Trusts in Essex, Kent, Surrey, Herts and Middlesex had discovered that it was possible to attract large numbers of members not particularly interested in the study of natural history or the publication of scientific papers, many of whom now found themselves turned into Londoners by Act of Parliament. Our area still extends beyond the boundaries of Greater London into Essex, Kent, Surrey and Herts, and also a little way into Bucks and now Berks. The L.N.H.S. coped with the growth of the county trusts around it by inviting representatives of them to attend its conservation committee. Thus enlarged, the committee ceased to be simply an organ of this Society and was allowed to operate as a semi-independent body with its own letterhead. This arrangement seemed satisfactory enough for many years, until it was overtaken by a new trend of thought in the world of local nature conservation. This can best be summed up as the view that in large cities the criteria for determining which sites deserve special attention have to be very different from those adopted by the ordinary, i.e. rural, county naturalists' trust. This trend has led to the formation of the London Wildlife Trust, mentioned in my opening sentence. The new body (it had its first annual general meeting three months ago) is still poor and feeble, but it has high and justifiable expectations of attracting many more members than we ever shall.

The creation of the London Wildlife Trust has produced the situation which seems to be normal in most parts of England, where there are a local natural history society and a local nature conservation body operating side by side. For instance in my home county of Kent we have the Kent Trust for Nature Conservation and also the Kent Field Club and for birdwatchers the Kent Ornithological Society. In Hertfordshire there are the Herts & Middlesex Trust and the Hertfordshire Natural History Society. In that case the main anomaly is that the trust also claims an interest in the former county of Middlesex. In the case of the county of Greater London the main anomaly now is that the London Natural History Society claims an interest in parts of adjoining counties. Whether or not this matters is a question the answer to which will depend very much on the view one takes of the Society's function.

The point I want to make now is that the formation of the London Wildlife Trust, far from obscuring the function of the L.N.H.S. as a promoter of nature conservation, has made its potential role very much clearer. The officers of the new body will, under suitable pressure, admit to their ignorance. They do not have ready access to the information they need for their work in identifying and later managing sites worth fighting for (in case any of them hear or see this, I should say that I do know that this is only a part of their work). Some at least of this information is available from our members, and it behoves us to organise ourselves in such a way that the information can be used. So we should ideally be able to say, and say quite quickly, whether a particular site is known to have anything special on it in the way of resident plant or animal life, whether it is known to be of value to feeding but non-resident animals, which include birds of course, and also presumably whether disturbance which might hinder geological or archaeological investigations should be prevented. If the site has not been accessible, making ignorance of its natural history excusable, we should be able to produce expert volunteers willing to help survey it in their spare time. It will I am sure be objected that fulfilment of this ideal is so far removed from what we can do with our present resources that it is quite wrong to mention it among our functions.

Certainly the present appearance of our programme makes us look very different from a body preoccupied with the collection and dissemination of biological records. An outside observer, looking at our printed programme to see what we do, might notice first the indoor meetings held in Central London, because of the bold type. Some of these are called 'general' and he might suppose that on such an occasion he would find most of the members filling a large hall, assembled to make learned intercourse on their abundant natural history observations before hearing a presentation designed to expand their interests. I dare say some of our general meetings are like that. Fresh in my memory is one at which I presided attended by one-fiftieth of our members, which got through its business in five minutes flat and then heard and saw a perfectly adequate account of an interesting stretch of country at least 30 miles from St Paul's Cathedral. On the subject of the use of our resources I should add that this meeting cost the Society exactly £3 for each person attending.

Or my imaginary enquiring reader of our programme might notice that most of our events are field trips, organised to cater for our sectional interests. He will see that many of them proceed, presumably on foot, from a convenient assembly point such as a railway station near to London, whereas others, more likely perhaps to attract his attention, visit remote or inaccessible places for which a hired coach is necessary. If I may be permitted to reminisce for a moment, when I first joined the London Natural History Society eighteen or nineteen years ago, having learned of it when I came across the run of *The London Naturalist* in a City of Westminster library, I got my programme in the post and went through it, as I still do, marking those events which I thought likely to interest me. The one botany field meeting that I can remember was in that programme was one I did not go to. The venue was Blackmoor Fruit Farm and one was instructed to meet at a crossroads the name of which I have forgotten. I pored over maps of the London area and could not find any Blackmoor. I know where it is now and have been there several times, once or twice on meetings of this Society, on the other occasions in private parties. The place is in Hampshire, a long way from London, and for many years had an extrordinary alien flora in consequence of the wool waste dug in round the bushes to thicken the light sandy soil. As with other larger areas, any part of which may turn up something of interest, it was useful to have a number of people visiting it together who could fan out in search of the plants. I would not suggest that the site was an odd one for an organised visit but it still seems to be an odd one for an organised visit by this Society. I suppose the justification for including in our programme outings to remote places (apart from the assumption that members want them) is that they give the opportunity for members to acquaint themselves with flowers, birds, geological formations or whatever it might be, which they are then able to recognise when they find them for themselves nearer home; in this way, the argument would run, we are furthering the knowledge of the natural history of our chosen area. I can only speak from my own experience when I say that I do not think that knowledge of a branch of natural history can really be built up in this way. There is no alternative to the long training imposed by constant individual use of reference manuals to identify the plants and animals one can find. For the larger animals, including birds and some of the largest insects, this training has of necessity to be conducted in the field. For most plants and very small animals, examination indoors with appropriate magnifying or dissecting equipment is necessary. I know that natural history is not all a matter of identification; but it does not seem to me to be possible to make useful contributions to other aspects of natural history unless they concern accurately identified natural organisms. Looked at from this standpoint, the function of a natural history society, the reason why a person should join it rather than pursue his interests alone, should be to do whatever is necessary to these pursuits, but beyond the resources of members individually.

Such a society could well be national in character and indeed there are national societies catering for every aspect of natural history. I would remind you that my topic is the function of a local natural history society. The distinctive character of a local natural history society should reflect that of its locality. In our case the distinctive feature of our territory is the enormous built-up area in the middle of it, but we are not, as it might be expected that we should be, conspicuously devoted to the study of urban natural history, of the constraints and the adaptations imposed on plants and animals by the conditions of life in a great city. The other relation between the society and its locality is the rôle the society ought to play in support of the needs of nature conservation locally, and it is to this that I must return. I have described it as principally a matter of collecting and evaluating records, and referring briefly back to our programme I should point out that until very recently nothing of what was found in our field meetings ever got recorded except in individual members' own notes, which made this Society one of the most inefficiently functioning natural history societies known to me. In particular I suggested that we ought to be able to produce a few expert volunteers if a site needed surveying at short notice. The notion of a 'flying squad' of naturalists is I believe a novel one and one which in London would be particularly difficult to put into effect, because of the character of our area, which makes travelling so much harder. I live at the edge of our area, in Kent. To get to Watford at the far side of it, thirty-five miles away, on a Saturday would take me nearly two hours by public transport, a little longer by car. To get to Dover, at the far end of Kent, over fifty miles as the crow flies, is an hour and a half away by road or rail. However it is my belief that if it were known that we were making the attempt to operate such a scheme it would help us to attract to membership of the Society experts in various branches of natural history who are known to live or work in London and for whom we have at present little to offer.

Having mentioned the information on sites of natural history interest which should be available from our members, and also the existence of people with similar information stored away who are not members, I have reached a point where I should reassure those present who are having difficulty relating what I have been saying to their own place in the Society. We will always welcome those who are content to watch and listen but not to contribute. I would guess that for a thousand members of the Society (in fact we have more than that, which makes us the largest local natural history society in the country) we have two hundred who are competent to locate and identify most of our birds, some forty or fifty who could name most of the naturally occurring flowering plants in the area with varying degrees of ease, perhaps a similar number who know most of our butterflies and smaller numbers who understand the other groups which matter in this context: the remaining insects and other arthropods, the bryophytes, etc. There appear to be about half a dozen conchologists living in London, but I only know that two of them are members. As one snail found in London this year was new to Britain and London also has the country's strongest populations of another, it is important that local studies of these animals' life histories, and by implication their conservation needs, should not be neglected. I said I thought my 'flying squad' notion would be difficult to put into effect. My main notion, concerning the organising of our records to the best effect, would also be difficult, but at least I have a glimmer of how it might be done. In my years as your recorder for flowering plants I have many times been asked, usually by the Assistant Regional Officer for the Nature Conservancy Council, what I can say about the flora of a given locality in London, or how rare in London a particular species is. Note that these questions only concern the administrative county of London, although the records we hold also come from places in five other counties. It does not seem to me to be good enough that my memory should be relied upon, or that recourse should have to be made to a large collection of handwritten cards stored in an upstairs room at my home.

Obviously there is a disadvantage to the Society in not having accommodation of its own to house its documentation, together with paid staff to attend to it. This disadvantage is thoroughly usual and I am not going to suggest ways of overcoming it. Other complications are caused by the form in which records are, and no doubt will continue to be, received. There are the conscientious members who send to the Society's recorders lists of anything at all unusual seen in the area, complete with specimens or photographs to support (or it might be to solicit) the identification of particularly difficult items. There are also members who report only very exciting discoveries. Field meetings produce notes of plants and animals seen. Site surveys done for conservation purposes ought to feed lists into some form of permanent record. Accounts by non-members published in our journals, like the publications of other societies, can be routinely scanned. I can assure you from my experience that even though only a few members may contribute records there is a mass of information to be sifted, some of it to be chucked out as of doubtful reliability, received in any order or none. Up to now the only way of coping with this mess has been to sort it by species. This produces a result which is useful if one wants information arranged by species but it does not make for easy collection of the information stored in the records concerning any given place. I did in fact once this year go right through the plant records looking for data on Oxleas Wood. The result was disappointing and I still do not know whether our botanically minded members of the past neglected it, visited it and found nothing, or were unable to gain access.

There is a way of storing records which allows data to be retrieved in any way one might reasonably want: all records of a named species, all records from a given place, all records made by a certain person, all butterfly records added in the past year, etc. This is Information Technology Year and I expect you have already heard all you want to about computer storage of data for quite a while, so I will spare you the technicalities, assuming that you are more interested to know how on earth we could meet the cost of the hardware, cope with the software and get all our existing records converted to such a system. I will tell you how. The Greater London Council has a capacious computer system of its own. It also has a professional biologist appointed to a new post this year and given a promise of a strong supporting staff and quite a substantial budget, with the result of improving the natural environment of the capital. Now the cat is out of the bag: all I have been saying to you this evening has been directed towards a demonstration of the case that can be made for the G.L.C. to spend money on its local natural history society, with the implication that the society needs to be confident that it deserves it. There are other implications too. Though I think the chances of getting a commitment from the G.L.C. are good I am not sure to what extent that commitment will extend beyond the present boundaries of London. It seems to me that at this time we should consider whether we ought to shrink our main recording area and make it co-terminous with the operating boundaries of the county administration, the county naturalist's trust and the regional division of the Nature Conservancy Council. I know that this would be considered a sad loss by many of our members who have got used to our circle, and regard Epping Forest or Staines Moor or Headley Heath or worst of all Bookham Common as an integral part of our area. It might, on the other hand, improve our relations with neighbouring county societies with whom we have been overlapping, sometimes rather awkwardly. Another effect would be to improve the quality of our records. In spite of our large membership we have, I think, been trying to do too much. If you look in our 'Atlas of breeding birds' you will find that there are some places in Essex, which are quite rural although less than twenty miles from St Paul's, which appear to have either no breeding birds at all or else fewer than any part of inner London. If, when you get the chance, you look at our plant atlas, you will find areas of Hertfordshire which had only half the number of species in 1965-76 which they had in the 1950s, another unrealistic consequence of our attempts to record in an area larger than we can explore as thoroughly as we should.

If we agree to limit our recording territory in this way there will be one more aspect of our function to sort out. Although we are the only natural history society which meets in Central London, there are also good naturalists who live and work away from the centre and come together as members of other local societies of whose doings we do not always get to hear. There are the Ruislip Natural History Society, the Hillingdon Natural History Society, the Harrow Natural History Society, the Croydon Natural History and Scientific Society, the Orpington Field Club, the Sidcup and District Natural History Society, of which I was myself president many years ago, and probably others unknown to me. When considering how best to take on board the accumulated knowledge of their members for the purposes I have outlined, I was struck by the fact that the local body which meets in the Hounslow area is not an independent society but a section of this one. I have been in touch with the committee which runs our so-called South-West Middlesex section to canvass their views on the merits and demerits of operating as part of a larger but still local society, which seems to be a unique arrangement. One member of that committee is also involved with the Spelthorne Natural History Society, which covers that area which used to be in Middlesex but is now in the administrative county of Surrey, so she is also aware of the advantages of independence. These (and I add to her remarks my own recollections of my time at Sidcup) are mainly of a social kind. It is practical for a large proportion of the members of a small local society to attend the indoor meetings, and it is easier to recruit new members, especially younger members who may well be introduced by their parents or older relatives. They pay lower subscriptions but in a smaller society they get less value for their money. In particular they do not, with the exception of the Croydon Society, have the resources to produce a printed journal as good as ours, to organise symposia, to build up a useful library or to run as full a programme as ours. I think the London Natural History Society should suggest to the other local societies in London, or at least to the smaller ones, that it should incorporate them and turn them into sections like the S.W. Middlesex section. They would continue to run their own programmes which would be printed as a part of ours, and paid for from the Society's funds. They would send a representative to Council. Their members would notice the difference chiefly in terms of increased subscriptions. With the money raised from the additional membership, and saved by reducing the number of indoor meetings in Central London, the Society would pay for a section of local reports in *The London Naturalist*.

My interest in such a scheme is that it would enlarge the network of members from which records could be drawn. I am sorry to keep harping on the subject of records. Having turned one of your recorders into your president for a couple of years, you are now getting what you deserve. It is my view that the collecting of worthwhile and usable records is the central function of a local history society, and I want to see this one functioning well.

The Flora of Southern Epping Forest Part 4: Gilbert's Slade†

by P. R. FERRIS*

Summary

A survey of the flora of Gilbert's Slade and the nearby areas of southern Epping Forest was undertaken during 1981 and 1982. Two hundred and thirty-four species of vascular plants were recorded during this period. A description of the survey area is given, and the species listed. Information is also presented for species known to have been found in this area at some time, but which were not re-found during the present survey.

Additional species found in the total study area since publication of the previous three parts of this paper are listed.

Introduction

This fourth and final part of the survey of southern Epping Forest initiated by the Wren Conservation Group (Ferris 1980, 1981, 1982) describes that area of Epping Forest which lies between Leyton Flats in the south and Walthamstow Wood in the north. Most of it lies within the London Borough of Waltham Forest, with a relatively narrow strip along the eastern edge in Redbridge. A map of the Gilbert's Slade area is presented in Figure 1.

Records of the plants of this area were gathered mainly during 1981 and 1982. At the same time other parts of the total study area described by Ferris (1980) continued to be searched. Table 2 lists additional records since the preparation of Parts 1, 2 and 3 of this work (Ferris 1980, 1981, 1982), with the aim of presenting as complete and accurate account as possible of the present flora of the remaining southern fragments of Epping Forest. It has also been felt desirable to list species known to have been recorded in the past in the area surveyed but not re-found. Table 3 summarises data drawn from the publications of Gibson (1862), Lister (1941) and Jermyn (1975) and from such sources as the Passmore Edwards Museum at Stratford and the Epping Forest Conservation Centre at High Beach. Some of the plants seen more recently may yet be re-discovered.

The tables present plants in the same sequence as Clapham, Tutin and Warburg (1962) which is also the source of the names used. The letters and numbers in the tables are co-ordinates for the corresponding figures of earlier papers, e.g. Manor Pond in Figure 1 is in C15. These squares are 250 × 250 m and are aligned with the National Grid.

Area covered by Part 4 of this survey

Gilbert's Slade proper is a stretch of open grassland in an otherwise mainly wooded part of Epping Forest. However, the name is used here to encompass a survey area which includes adjacent and nearby forest land. The whole of this area lies between Snaresbrook Road in the south and the Waterworks Corner roundabout and the North Circular Road in the north. To the east, fences separate the forest from housing or playing-fields. To the west, boundaries consist of the road called Forest Rise, fences which separate the land from allotments or buildings, and Becontree Avenue (Fig. 1). A number of buildings lie within these boundaries, particularly in the south, and include a church, a public house, a school and dwelling houses.

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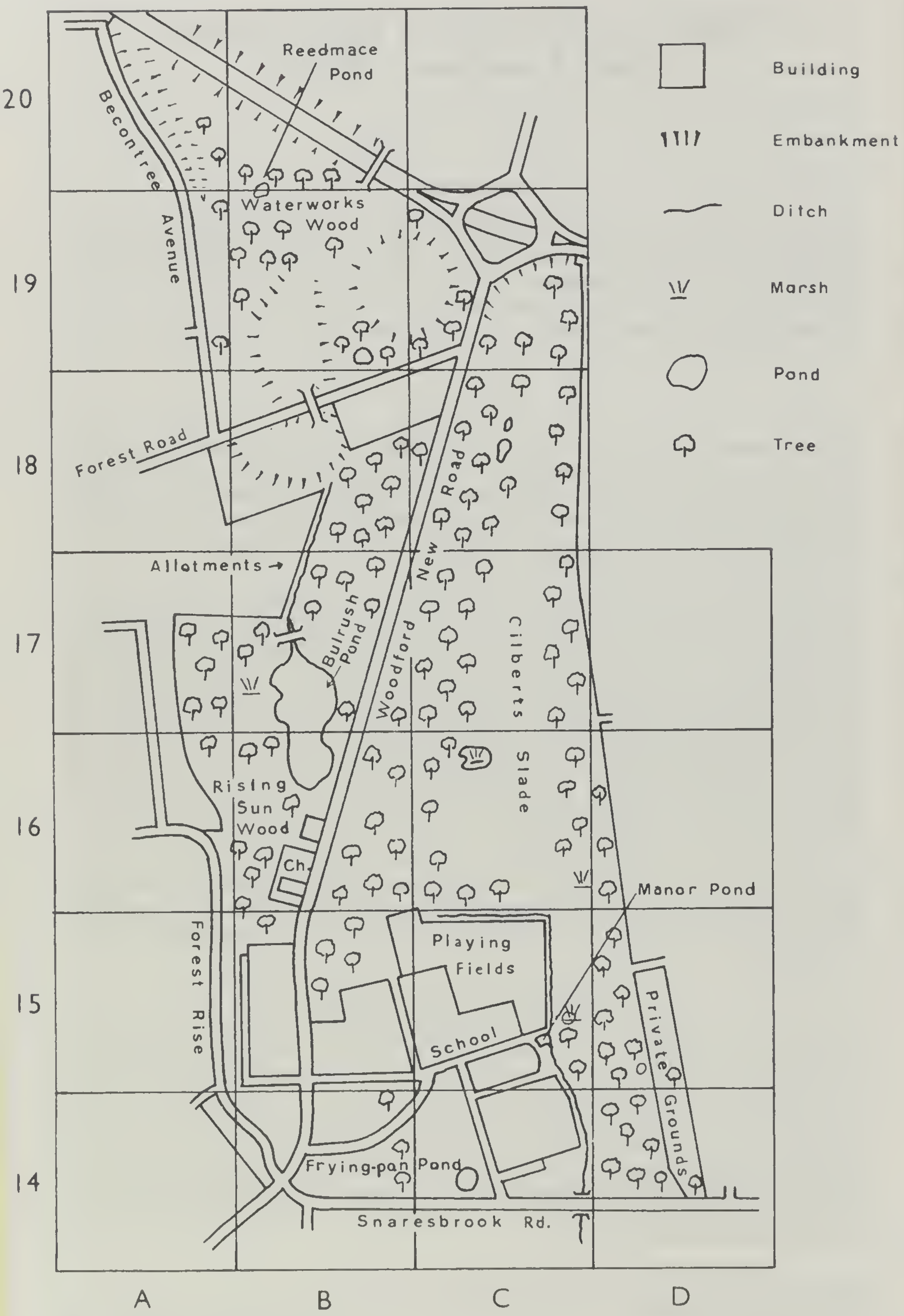

Fig. 1. Gilbert's Slade, 1982.

The total area is about 75 hectares, predominantly of woodland, but with pieces of grassland as well as ponds and other wet areas. This predominance of woodland gives Gilbert's Slade a very different aspect in general from that of either Wanstead or Leyton Flats, and it differs too from the landscaped environment of Wanstead Park. The southern end of the area lies, like the adjacent Leyton Flats, on the river gravel deposits of the Boyn Hill terrace at about 30 m above sea level and the rest of it is principally on London Clay, rising in the north to approximately 55 m.

A number of streams or ditches are present in the area, flowing generally north to south, although some of these may lie empty except at times of high rainfall. During such periods however, many temporary watercourses may be formed, particularly in the south part of Gilbert's Slade proper. Ponds or wet hollows are scattered about the whole area, the largest of these being Bulrush Pond. There are a number of marshy spots.

There is perhaps slightly less disturbance here as a whole than in the three areas of southern Epping Forest previously considered. However, even Gilbert's Slade suffers the consequences of being close to east London. The most popular parts of the area are the vicinity of Bulrush Pond – which is licensed for boating – and in the open region of Gilbert's Slade itself which is used by both pedestrians and equestrians, as are the main tracks which run through it.

Although the area is divided into three major sections by Woodford New Road and by Forest Road, these roads do not relate to ecological boundaries. It will therefore be convenient, when describing the area in detail, to divide it differently, starting from the southern end and working northwards.

Frying-pan Pond area

The south-west corner of the area is somewhat detached from the rest by Forest School and three groups of residential blocks, and is both surrounded and dissected by a number of roads. It consists in the main of open grassland with trees lining the roads, and the Frying-pan Pond. This pond is so called by people living nearby because of its shape and appearance — simply a shallow bowl with what may once have been a ditch in the north-west providing the 'handle'. Broad-leaved pondweed *Potamogeton natans* is plentiful here, and a small amount of bulrush *Schoenoplectus lacustris* is also present. Soft rush *Juncus effusus* and jointed rush *J. articulatus* as well as the common spike-rush *Eleocharis palustris* are associated with the pond's margin. In the grassland near to the pond heath rush *J. squarrosus* and mat grass *Nardus stricta* are present, and elsewhere hoary cress *Cardaria draba*, upright hedge-parsley *Torilis japonica* and lesser stitchwort *Stellaria graminea* may be noted. The borders of the area near to the houses contain garden outcasts such as spring beauty *Montia perfoliata*, wood forget-me-not *Myosotis sylvatica* and spotted dead-nettle *Lamium maculatum*. Also in similar locations are such colonisers of disturbed ground as ivy-leaved speedwell *Veronica hederifolia*, Buxbaum's speedwell *V. persica* and a white form of the red dead-nettle *Lamium purpureum*. Garden outcasts, including greater celandine *Chelidonium majus*, may also be found east of the road called The Forest in the strip of land between the houses and Snaresbrook Road. In the more grassy parts of this locality, to the east, there is an abundance of tormentil *Potentilla erecta* and heath bedstraw *Galium saxatile*, reminiscent of similar areas on Leyton Flats. At this point, a south-flowing stream is encountered, which eventually flows into the Eagle Pond on Leyton Flats. Northwards, this stream is bounded on one side by houses and on the other by a track and the woodland which extends towards Gilbert's Slade proper.

The southern woodland and private land

The woodland which stretches northwards from Snaresbrook Road towards the open area of Gilbert's Slade is predominantly of English oak *Quercus robur*, with hornbeam *Carpinus betulus* and some silver birch *Betula pendula*. Holly *Ilex aquifolium* is also common here as it is in many parts of the whole area. The eastern boundary of the forest here consists of a ditch and a concrete fence. Beyond the fence, and thus outside Epping Forest and the study area proper, is a plot of disused land about 400 m in length, stretching north from Snaresbrook Road between the Forest and nearby buildings. This land is very overgrown and, being private, less disturbed than the Forest itself. Some interesting plants are to be found here, including a luxuriant patch of bamboo *Sasa*. Also present are common horsetail *Equisetum arvense*, male fern *Dryopteris filix-mas*, cuckoo flower *Cardamine pratensis* and hairy bittercress *C. hirsuta*. On the Forest side of the fence some specimens of remote sedge *Carex remota* are situated by the ditch, and also some marsh thistle *Cirsium palustre*. A very small pond near the fence often contains rubbish as the relics of children's games, but also provides a habitat for a variety of plant species that manage to persist. These include a water starwort *Callitriche*, Canadian pondweed *Elodea canadensis*, narrow-leaved water-plantain *Alisma lanceolatum* and common duckweed *Lemna minor*. Another patch of remote sedge is present by the pond, and willow *Salix* overshadows it.

Within the woodland are some small grassy open areas in which species such as tormentil, creeping willow *Salix repens* and many-headed woodrush *Luzula multiflora* may be found. Elsewhere, three-veined sandwort *Moehringia trinervia* and patches of enchanter's nightshade *Circaea lutetiana* are to be found near woodland paths. At the west edge of the wood, along which flows the stream to the Eagle Pond, garden outcasts from the nearby buildings have included honesty *Lunaria annua* and a yellow crocus *Crocus*.

At the north-east corner of these buildings an open area of grassland is encountered which separates the houses from the Forest School, at the south-west corner of which lies Manor Pond. This pond, which derives its water from the previously mentioned stream, is in its present state the result of extensive 'tidying-up' of an older, very overgrown pond in early 1980. Some of the plants that are now present may have been deliberately introduced at that time. Yellow flag-iris *Iris pseudacorus* is prominent in clumps at the edge, where also are found celery-leaved crowfoot *Ranunculus sceleratus* and trifid bur-marigold *Bidens tripartita*. Present in the water are water-plantain *Alisma plantago-aquatica* and common duckweed, while on the bank are two large crack-willows *Salix fragilis* as well as some Japanese privet *Ligustrum ovalifolium*, which is also present more abundantly within the school grounds. The banks of the stream and the edge of the woodland in the vicinity have been much disturbed recently, partly in the process of re-forming Manor Pond. A number of species are present which have taken advantage of this situation. These include opium poppy *Papaver somniferum*, hedge mustard *Sisymbrium officinale*, cleavers *Galium aparine*, groundsel *Senecio vulgaris* and pineapple weed *Matricaria matricariodes*.

Northwards, the woodland begins to thin out as the southern end of Gilbert's Slade proper is reached. The stream by the school and its playing-fields has a more luxuriant vegetation associated with it than the adjacent grassland. Species include great willowherb *Epilobium hirsutum*, willow *Salix*, gipsywort *Lycopus europaeus*, soft rush and great water-grass *Glyceria maxima*. Away from the stream, floating sweet-grass *G. fluitans* has choked a small pond at the edge of the grassland just to the north-east of Manor Pond.

Gilbert's Slade

Gilbert's Slade itself is an area of open grassland which stretches northwards until it narrows to a track leading through the trees to the Waterworks Corner roundabout. Grasses which may be found in various locations in the Slade include heath grass *Sieglingia decumbens*, tufted hair-grass *Deschampsia caespitosa* and mat-grass *Nardus stricta*. Heath rush *Juncus squarrosus* and slender rush *J. tenuis* are also present, as well as common sedge *Carex nigra* and oval sedge *C. ovalis*. A small amount of petty whin *Genista anglica* persists, and common cow-wheat *Melampyrum pratense* is to be found beneath the trees at the edge of the Slade in an area where tormentil is particularly abundant. A few ponds or marshy areas exist; plants that are paricularly associated with these include toad rush *Juncus bufonius* and jointed rush *J. articulatus,* floating sweet-grass and great water-grass.

The woodland which borders Gilbert's Slade consists mainly of English oak, hornbeam and holly. This woodland comprises the greater part of the whole area on both sides of Woodford New Road as far north as Forest Road and Waterworks Corner, apart from Gilbert's Slade and the Bulrush Pond and its adjacent area of marshy ground to the west of Woodford New Road. South of Bulrush Pond and the Rising Sun public house is St Peter's Churchyard, which, although not strictly part of the study area, deserves a mention because of the wood anemone *Anemone nemorosa* and lesser celandine *Ranunculus ficaria* which occur abundantly in the north-west corner of the churchyard, but hardly at all in the adjacent forest area.

Bulrush Pond

Bulrush Pond and its immediate surroundings have produced a greater number of species in one or two squares than perhaps any other part of the whole study area. Of particular interest in 1981 was an abundance of the water fern *Azolla filiculoides,* while other plants present include rigid hornwort *Ceratophyllum demersum,* watercress *Ranunculus nasturtium-aquaticum,* bog stitchwort *Stellaria alsine,* brooklime *Veronica beccabunga* and ivy duckweed *Lemna trisulca.* Just to the west of the pond, a different plant community is associated with an area of wet marshy land which further increases the variety of plants in this vicinity. Here may be found patches of heath rush, slender rush, toad rush and soft rush, as well as oval sedge and heath grass. Nearby, though not associated with the wet areas, honesty *Lunaria annua* and London pride *Saxifraga spathularis* × *umbrosa* are outcasts possibly from the nearby allotments.

Waterworks Wood

This area is separated to some degree from the rest of Gilbert's Slade by Forest Road and that part of Woodford New Road leading to the Waterworks Corner roundabout. The construction of this roundabout and the re-routing of nearby roads in 1970 involved considerable disturbance and landscaping of parts of this area, so that much of the flora is of comparatively recent origin and of generally common plants. These include such species as annual meadow grass *Poa annua,* cocksfoot *Dactylis glomerata,* couch *Agropyron repens,* black medick *Medicago lupulina* and coltsfoot *Tussilago farfara.* By Becontree Avenue, numerous garden outcasts or deliberately planted species occur, such as Lawson's cypress *Chamaecyparis lawsoniana,* a *Berberis,* an azalea *Rhododendron* and Spanish broom *Spartium junceum.* Snowberry *Symphoricarpos rivularis* is abundant at the north end of the road. The woodland area which was not disturbed during the road-building programme is predominantly of English oak, hornbeam and holly, with sycamore *Acer pseudoplatanus* and silver birch saplings also occurring in some parts. Within the wood lies Reedmace Pond, named from the presence of great reedmace *Typha latifolia.* Other plants present include water pepper *Polygonum hydropiper,* gipsywort, floating sweet-grass and great water-grass.

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TABLE 1. Plants recorded from Gilbert's Slade during 1981 and 1982.

PTERIDOPHYTA

Equisetum arvense common horsetail. Only in private land in D14.
Pteridium aquilinum bracken. Common, in B17, B18, B19, C16, C18, D14, D15.
Phyllitis scolopendrium hart's-tongue fern. Only on a wall in College Place, B15.
Dryopteris filix-mas male fern. Uncommon. B18, D14.
Azolla filiculoides water fern. Abundant in Bulrush Pond, B16/B17, during 1981.

GYMNOSPERMAE

Chamaecyparis lawsoniana Lawson's cypress. Planted by Becontree Avenue in A19.
Taxus baccata yew. A single small, possibly planted, tree in the wood in B15.

ANGIOSPERMAE: DICOTYLEDONES

Anemone nemorosa wood anemone. Only in the north-west corner of St. Peter's Churchyard in B16, where abundant.
Ranunculus acris meadow buttercup. Common. A18, A19, A20, B14, B16, B17, B18, B19, B20, C15, C16, D14, D15.
R. repens creeping buttercup. Less common than the previous species. B17, B19, C14, C15, C18, D14.
R. bulbosus bulbous buttercup. Uncommon. B18, C14.
R. flammula lesser spearwort. North part of Bulrush Pond in B17, near the pond in C16, in the ditch by the wall and in private land in D14.
R. sceleratus celery-leaved crowfoot. By ponds and wet areas in B17, B19, C15, C16 and C17.
R. ficaria lesser celandine. A few patches in A20, B15, B16, B19 and C14.
Berberis sp. barberry. A shrub planted by Becontree Avenue in A20.
Ceratophyllum demersum hornwort. In Bulrush Pond, B17.
Papaver somniferum opium poppy. By road-side in B15 and on disturbed ground in C15.
Chelidonium majus greater celandine. Garden outcast in C14.
Brassica oleracea cabbage. By roundabout north of Gilbert's Slade in C19.
B. rapa turnip. A casual by Woodford New Road in B17, 1981.
Cardaria draba hoary cress. A19, A20, B14, B18, B19, C19.
Capsella bursa-pastoris shepherd's purse. A16, A18, B14, B18, C15, D14.
Lunaria annua honesty. Of garden origin in B17 and C14.
Cardamine pratensis cuckoo flower. Only in private land in D14.
C. hirsuta hairy bittercress. Only in private land in D14.
Rorippa nasturtium-aquaticum watercress. At north end of Bulrush Pond in B17.
R. sylvestris creeping yellowcress. Bank of Bulrush Pond in B17.
Erysimum cheiranthoides treacle mustard. By roundabout north of Gilbert's Slade in C19.
Alliaria petiolata garlic mustard. Near buildings in B18 and C14.

Silene dioica red campion. On roadside bank at north end of Waterworks Wood in B19.
Sisymbrium officinale hedge mustard. A16, A19, B19, C15.
Silene alba white campion. By roundabout north of Gilbert's Slade in C19.
Cerastium holosteoides common mouse-ear. Common. A20, B16, B17, B18, B19, C14, C15, C16, C19.
Stellaria media common chickweed. Common. A14, A15, A18, A20, B14, B16, B17, B18, B19, B20, C14, C15, C19, D14, D15.
S. holostea greater stitchwort. One plant only by Woodford New Road in B17.
S. graminea lesser stitchwort. In grassland, B14.
S. alsine bog stitchwort. North end of Bulrush Pond in B17.
Sagina procumbens procumbent pearlwort. By Woodford New Road in B14.
Moehringia trinervia three-nerved sandwort. Uncommon in woodland in D15.
Montia perfoliata spring beauty. Plentiful in 1981 by the road called The Forest in C14.
Atriplex hastata spear-leaved orache. A20, B16, C15.
Tilia × *europaea* common lime. By roadsides in A14 and B14.
Malva sylvestris mallow. By Forest Rise road-side in B14 and by Woodford New Road in B17.
Geranium dissectum cut-leaved cranesbill. On grassy road-side bank at north end of Waterworks wood in A20 and by roundabout at north end of Gilbert's Slade in C19.
Oxalis articulata pink oxalis. A garden outcast by road-side in B15.
Oxalis sp.cf. *corymbosa* purple garden oxalis. By Becontree Avenue in A18.
Acer pseudoplatanus sycamore. Common, but more so as saplings. A16, A18, A20, B14, B15, B16, B17, B18, B19, B20, C14, C15, C18, D14, D15.
Aesculus hippocastanum horse-chestnut. A tree in A18, seedlings by Becontree Avenue in A20, a tree and seedlings by The Forest in C14.
Ilex aquifolium holly. Common. A17, A18, A20, B14, B15, B16, B17, B18, B19, B20, C14, C15, C18, C19, D14, D15, D16.
Laburnum anagyroides common laburnum. By houses in A18 and beneath trees near Forest Road in B19.
Genista anglica petty whin. Near to the pond in C16.
Ulex europaeus gorse. B14, B17, B18, C14, C18, D14.
Sarothamnus scoparius broom. More common than previous species. In A15, A18, A19, A20, B14, B17, B18, B20, C14, C15, C16, D15, D16.
Spartium junceum Spanish broom. Planted by Becontree Avenue in A19 and A20.
Medicago lupulina black medick. A18, A19, A20, B14, B18, B19, B20, C15, C16, C19.
Trifolium repens white clover. A16, A18, A19, A20, B14, B17, B18, B19, B20, C15, C16, C18, C19, D15.
T. pratense red clover. A19, A20, B14, B18, B19, C16, C18, C19.
Lotus corniculatus birdsfoot trefoil. Uncommon. A20, B14, C16.
Vicia hirsuta hairy tare. North end of Waterworks Wood in B19 and north of Gilbert's Slade in C19 only, in grass associated with road improvement scheme.
V. tetrasperma smooth tare. As above in B20.
V. cracca tufted vetch. Grassland in B14.
V. sativa common vetch. A20, B18, B19, B20, C16, C19, D14.
Lathyrus pratensis meadow vetchling. A few patches in grassland areas. A20. B14. B18, B19, C19.
L. latifolius broad-leaved pea. A20, B18, D14.
Rubus fruticosus agg. bramble. A15, A16, A17, A19, A20, B14, B16, B17. B18. B19, C14, C15, C19, D14, D15.
R. laciniatus cut-leaved bramble. A16, B17, D15.
Potentilla erecta tormentil. Particularly in the more acid grassland of Gilbert's Slade proper, and in clearings in the woods nearby. C14. C16, C17, C18, D14. D15.
P. reptans creeping cinquefoil. Only on the grassland near Forest Rise in B14.
Rosa arvensis field rose. East edge of Gilbert's Slade in C17.
R. canina dog rose. A15, A20, B19, C19.
Prunus spinosa blackthorn. Particularly plentiful in south part of Rising Sun Wood. A18. A19, B14, B15, B16, B18, C14.
P. domestica subsp. *domestica* plum. A tree in B19.
P. avium wild cherry. A20 by Becontree Avenue.
Crataegus monogyna hawthorn. A19, A20. B14, B15, B16, B18, B19, C15. C19, D14.
Sorbus aucuparia rowan. A17, B15, B16, B17, B20, C14, C16, C18, C19, D14, D15.
S. aria whitebeam. Saplings only near wall at edge of C19.
Pyrus communis pear. By Becontree Avenue in A20.
Malus sp. apple. By Becontree Avenue in A20; south fence of Rising Sun public house in B16.

Saxifraga spathularis × *umbrosa* London pride. Growing as an outcast from adjacent allotments in B17.

Ribes uva-crispa gooseberry. By the west edge of Woodford New Road in B17.

Epilobium hirsutum great willowherb. A20, B17, B18, B19, C15, D14.

E. adenocaulon American willowherb. The only record is from north of Bulrush Pond in B17.

Chamaenerion angustifolium rosebay willowherb. Common. A14, B14, B16, B17, B19, B20, C16, C18, C19, D14, D15, D16.

Circaea lutetiana enchanter's nightshade. Behind the Rising Sun public house in B16 and in woodland in D15.

Callitriche sp. Species undetermined. B17, C14, C15, D14.

Hedera helix ivy. B15, B16, B17, B18, B19, C14, C15, D14.

Anthriscus sylvestris cow parsley. A14, A15, A20, B14, B15, B18, B19, C14, C19.

Torilis japonica hedge parsley. Plentiful on bank by Woodford New Road in B14.

Aegopodium podagraria ground elder. A20, B15, B18.

Heracleum sphondylium hogweed. A20, B19, B20, C19.

Euphorbia helioscopia sun spurge. Only by roadside in B15.

Polygonum aviculare agg. knotgrass. A16, A18, A19, A20, B14, B17, B19, C17, D14.

P. persicaria redshank. A17, A19, B16, B20, C15, C16, D14.

P. lapathifolium pale persicaria. B20, C15, D15.

P. hydropiper water-pepper. B17, B19, D14, D15.

P. cuspidatum Japanese knotweed. B14, B15, B19 and D14 in private land.

Rumex acetosella sheep's sorrel. A13, B18, B19, B20, C14, C16, C17, C18, C19.

R. acetosa common sorrel. A20, B18, C16, D15.

R. crispus curled dock. B14, B19, C19.

R. obtusifolius broad-leaved dock. Common. A15, A16, A20, B14, B15, B17, B18, C14, C15, C19, D14 (in Forest and private land), D15.

R. sanguineus red-veined dock. Only recorded from near Reedmace Pond and in a wood near Forest Road in B19.

R. conglomeratus clustered dock. B14, B15, B16, B17, B19, C14, C15, C19, D14.

Urtica dioica nettle. Common. A15, A19, A20, B14, B15, B16, B17, B18, B19, C14, C15, C19, D14, D15.

Humulus lupulus hop. Between the church and the public house in B16.

Cannabis sativa hemp. Some planted specimens in A17 in 1981.

Ulmus sp. elm. Suckers by the stream in C15 and by Snaresbrook Road in D14.

Betula pendula silver birch. Common. A16, A20, B14, B17, B18, B19, B20, C14, C15, C16, C18, D14, D15.

Carpinus betulus hornbeam. Pollarded trees are common and form a major part of the woodland in much of the areas. A18, A19, A20, B15, B16, B17, B18, B20, C18, C19, D15, D16.

Fagus sylvatica beech. A few trees in D14.

Castanea sativa sweet chestnut. One tree at the north-west edge of the wood in B18.

Quercus cerris Turkey oak. In the wood in A20 and also one tree in D15.

Q. robur English oak. With hornbeam forming a major part of the woodland. A16, A17, A18, A19, A20, B14, B16, B17, B18, B20, C14, C16, C18, C19, D14, D16.

Salix fragilis crack willow. Two trees by Manor Pond in C15; by a small pond just to the north of Forest Road in C19.

Salix spp. sallow. Species of *Salix* have not been determined, but it is thought that both *S. cinerea* and *S. caprea* are present. A15, A16, B17, C15, C16, C18, D14.

S. repens creeping willow. Some patches present in an open area of the wood in D15.

Fraxinus excelsior ash. Scattered trees in A18, A19, B14, B18, B20, D15.

Syringa vulgaris lilac. At north-east corner of allotments in B18.

Ligustrum vulgare common privet. One plant among trees by road south-east of Frying-pan Pond, in C14.

L. ovalifolium Japanese privet. At north-east corner of allotments in B18 and by Manor Pond in C15.

Vinca minor lesser periwinkle. Outcast from houses in C14.

Myosotis sylvatica wood forget-me-not. A garden outcast occurring in B14, B15 and C14.

Convolvulus arvensis field bindweed. A18, A20, B14, B19.

Calystegia sepium subsp. *sepium* hedge bindweed. Only recorded from rear of church in B16.

C. sepium subsp. *sylvatica* great bindweed. A20, B14, B15, B18, C15.

Solanum nigrum black nightshade. Only found in a ditch in Waterworks Wood in B20.

S. dulcamara bittersweet. B16, B17, B19, C14, C15, C19.

Cymbalaria muralis ivy-leaved toadflax. On the walls of the school in B15.

Digitalis purpurea foxglove. A17, B15, B17, C14, C18, C19.
Veronica beccabunga brooklime. At the north end of Bulrush Pond in B17.
V. hederifolia ivy-leaved speedwell. A15, A20, B14, B15, B18, C14, C19.
V. persica Buxbaum's speedwell. One plant by Becontree Avenue in A20 and also by St Peter's Avenue in B14.
Melampyrum pratense common cow-wheat. Patches just in the wood at the north-west end of Gilbert's Slade in C17 and C18.
Mentha aquatica water mint. By Bulrush Pond and by the roadside in B17.
Lycopus europaeus gipsywort. By Bulrush Pond in B17 and by Reedmace Pond in B19.
Stachys sylvatica hedge woundwort. By the fence at the west edge of Rising Sun Wood in A16 and in a grassy clearing in the wood in D15.
Ballota nigra black horehound. A15, A18, A20, B14, B16, B17, C14, C15, C19.
Lamium purpureum red dead-nettle. A20, B14, B17, C15, C19.
L. album white dead-nettle. Only found by Becontree Avenue road-side in A20.
L. maculatum spotted dead-nettle. A garden outcast near Becontree Avenue in A20 and by St Peter's Avenue in B14.
Glechoma hederacea ground ivy. By Forest Road-side in C19.
Teucrium scorodonia wood sage. By Woodford New Road near to Bulrush Pond in B17.
Plantago major great plantain. A16, A18, A20, B17, C15, C16, C17, D14, D15.
P. lanceolata ribwort plantain. A16, A19, A20, B14, B18, B19, C19, D14.
P. coronopus buck's-horn plantain. One plant between Bulrush Pond and Woodford New Road in B17 and also by the road called The Forest in C14.
Galium saxatile heath bedstraw. Abundant in rough grassland near Snaresbrook Road in C14 and also near to Forest Road in C19.
G. aparine cleavers. A14, B14, B15, B18, C14, C15, C19.
Sambucus nigra elder. A14, A15, A20, B14, B15, B16, B17, B18, B19, C14, C15, C19, D14, D15 (including private land).
Symphoricarpos rivularis snowberry. Plentiful where it occurs in A16, A20 and B18.
Bidens tripartita trifid bur-marigold. By pond-sides in B16, B17, C16 and D14.
Senecio squalidus Oxford ragwort. A16, A18, A20, B14, B15, B17, B18, B19, C15, C19, D14.
S. vulgaris groundsel. A15, A19, A20, B14, B15, B18, B20, C14, C15, C16, D14.
Tussilago farfara coltsfoot. A16, B17, C15, C19.
Conyza canadensis Canadian fleabane. By road-side in B15.
Bellis perennis daisy. Uncommon. B14, B19, C15, C19.
Achillea millefolium yarrow. A16, A18, A19, A20, B14, B15, B17, B18, B19, C14, C15, C19, D14.
Tripleurospermum maritimum scentless mayweed. By Becontree Avenue in A20.
Matricaria recutita scented mayweed. By Becontree Avenue in A20; near houses in B15; on grassy road-side bank at north end of Waterworks Wood in B19.
M. matricarioides pineapple weed. Mostly on bare or disturbed ground in A16, A19, B14, B18, C15, C19, D14.
Artemisia vulgaris mugwort. A19, A20, B14, B17, B18, C19.
Arctium minus lesser burdock. A15, A16, A18, B14, B15, B17, B18, B19, C15, C19, D15.
Cirsium vulgare spear thistle. A16, A18, A20, B14, B17, B18, C15, C19.
C. palustre march thistle. Only in wet ground at the east edge of the Forest in D14.
C. arvense creeping thistle. A16, A18, A19, A20, B14, B15, B17, B18, B20, C14, C15, C16, C19, D14, D15 (including private land).
Centaurea nigra black knapweed. Only at the south edge of Forest Road in B18.
Lapsana communis nipplewort. Only found by the west edge of Woodford New Road in B17.
Hypochoeris radicata common cat's-ear, B14, B19, C15, C16, C17, C19, D14, D15.
Leontodon autumnalis autumn hawkbit. Only recorded from a grassy area to the west of Woodford New Road in B16.
Picris echioides bristly ox-tongue. Only recorded from grassland near to the roundabout at the east side of Waterworks Wood in C19.
Tragopogan pratensis goat's-beard. Only on grassy area in A14/B14.
Lactuca serriola prickly lettuce. By Becontree Avenue in A19 and on grassy bank at north-end of Waterworks Wood in B20.
Sonchus oleraceus smooth sow-thistle. A16, A18, B14, B15, D14.
S. asper prickly sow-thistle. Only by Becontree Avenue in A20 and by the side of a ditch in C15.
Hieracium spp. hawkweed. A16, C19.
Crepis vesicaria beaked hawk's-beard. B17, B19, C15, C19.
C. capillaris smooth hawk's-beard. Only recorded from grassland in C15.

Taraxacum officinale agg. dandelion. A14, A15, A16, A18, A20, B14, B16, B18, B19, B20, C14, C15, C19, D14, D15.

T. laevigatum agg. lesser dandelion. At west edge of Woodford New Road in B14.

ANGIOSPERMAE: MONOCOTYLEDONES

Alisma plantago-aquatica common water-plantain. In Manor Pond, C15.

A. lanceolatum narrow-leaved water-plantain. Pond in D14.

Elodea canadensis Canadian pondweed. Bulrush Pond in B17 and small pond in D14.

Potamogeton natans broad-leaved pondweed. Frying Pan Pond in C14.

P. pusillus lesser pondweed. Bulrush Pond in B17.

P. crispus curled pondweed. Bulrush Pond in B17.

Endymion non-scriptus bluebell. A20, B15, B16, B18, B19, C15, C18, D14, D15.

Muscari sp. grape-hyacinth. In grassland in A13/A14 and B14.

Juncus squarrosus heath rush. West of Bulrush Pond in B17; west of Frying Pan Pond in C14; marshy area in C16; in Gilbert's Slade C17.

J. tenuis slender rush. West of Bulrush Pond in B17 and south-west end of Gilbert's Slade in C16.

J. bufonius toad rush. Near Bulrush Pond in B17; C16 and C17 in Gilbert's Slade.

J. inflexus hard rush. Grassy area of A13/A14 and west of small pond in B19.

J. effusus soft rush. A17, B16, B17. B19, B20, C14, C15, C16. C17, C18, C19, D14 (including private land), D15.

J. conglomeratus compact rush. Only in Gilbert's Slade in C17.

J. acutiflorus sharp-flowered rush. Only in C16.

J. articulatus jointed rush. At south-east corner of Bulrush Pond in B16; by Frying-pan Pond in C14; by pond and in damp areas of C16.

Luzula multiflora many-headed woodrush. Near to overgrown pond in C15; woodland in Gilbert's Slade C18; grassy area in woodland in D15.

Narcissus spp. narcissi. Garden outcasts by Forest Rise road-side in A16 and also in Gilbert's Slade in B14.

Iris pseudacorus yellow flag-iris. North edge of Bulrush Pond in B17 and in Manor Pond C15

Crocus spp. Crocuses of garden origin occur near the road called The Forest in C14 and also in woodland at the east edge of Gilbert's Slade in C17.

Dactylorchis praetermissa fen orchid. A number of long-established plants occur in marshy woodland in the south of the area.

Arum maculatum cuckoo-pint. Only found by house wall just south of Forest Road in A18.

Lemna trisulca ivy duckweed. Bulrush Pond in B17.

L. minor common duckweed. Ponds and ditches in B17, C14. C15, C19, D15.

Typha latifolia great reedmace. Small Pond and Reedmace Pond in B19.

Eleocharis palustris common spike-rush. By Frying-pan Pond in C14.

Scirpus lacustris bulrush. Frying-pan Pond in C14.

Carex acutiformis lesser pond sedge. South end of Bulrush Pond in B16.

C. hirta hairy sedge. Only found in grassy patch in woodland in C18.

C. nigra common sedge. By marshy area at southern end of Gilbert's Slade in C16.

C. remota remote sedge. Plentiful by pond and ditch in D14.

C. ovalis oval sedge. B17, B19. C16, C17, C18. C19.

Sieglingia decumbens heath grass. B17, C15, C16, C17.

Glyceria fluitans floating sweet-grass. B17. B19, C15, C16, C18, D14.

G. maxima great water-grass. B16, B17, B19, C15, C16. C18.

Festuca ovina subsp. *ovina* sheep's fescue. B17, C15, C16, C17.

Lolium perenne perennial rye-grass. A16, A18, A19, A20, B17, B18, C16.

Poa annua annual meadow-grass. A15. B14, B16, B19. C14, C15, C16. C18. C19.

P. pratensis smooth meadow-grass. Only recorded from beside the stream in C14.

P. trivialis rough meadow-grass. Only recorded from beside the stream in C14.

Dactylis glomerata cock's-foot. A16, A18, A19. B14. B15, B18, B19. B20, C14, C19. D14.

Cynosurus cristatus crested dog's-tail. C16, B18, B19, C16, C19.

Anisantha sterilis barren brome. Extreme north-west corner of Waterworks Wood in A20; by track in D14: by wall in D15.

Agropyron repens couch. B17, B19, C15. (Probably under-recorded).

Hordeum murinum wall barley. A18, A19. A20. B14, B16. B17, B19. C15, C19.

Arrhenatherum elatius false oat-grass. By west side of Woodford New Road in B17; east edge of Gilbert's Slade in C17; woodland at north end of Gilbert's Slade in C19.

Holcus lanatus Yorkshire fog. B14. B16, B17, B18, B19, C15, C16, C17, C19, D14, D15.

H. mollis creeping soft-grass. Only recorded from west edge of Woodford New Road in B17.

Deschampsia caespitosa tufted hair-grass. Gilbert's Slade in C17; near roundabout at east edge of Waterworks Wood in C19.
D. flexuosa wavy hair-grass. Only recorded from woodland at edge of Gilbert's Slade in C18.
Phleum bertolonii smaller cat's-tail. A19, C15, C16.
P. pratense timothy. A19, B16 (Probably under recorded).
Alopecurus pratensis meadow foxtail. C14, C19.
A. geniculatus marsh foxtail. Marshy area at east edge of C15/C16.
Anthoxanthum odoratum sweet vernal-grass. Marshy area in C17 and by series of wet hollows in C18.
Nardus stricta mat grass. C14, C15, C16, C17.
Sasa sp. bamboo. Luxurient clump in private land in D14.

TABLE 2. Species recorded since publication of Parts 1, 2 and 3 of this survey.

Abbreviations

Part 1
HP Heronry Pond
OW Ornamental Water
PP Perch Pond
SM Shoulder of Mutton Pond

Part 2
BW Bush Wood (South)
WF Wanstead Flats

Part 1: Wanstead Park

Ranunculus lingua great spearwort. Edge of SM, J6/I7.
Nymhaea alba white water-lily. East bank of OW,N7.
Papaver somniferum opium poppy. Disturbed ground (after pipe-laying). L7.
Fumaria officinalis common fumitory. Disturbed ground, L7.
Brassica rapa subsp. *campestris* turnip. Bank of Roding.
Armorica rusticana horse-radish. Rear of Temple in enclosure, L7.
Moehringia trinervia three-nerved sandwort. Chalet Wood, L7, K7.
Arenaria leptoclados lesser thyme-leaved sandwort. Disturbed ground, L7.
Chenopodium polyspermum many-seeded goosefoot. River Wood, M9.
Geranium robertianum herb robert. By house fence, 16.
Impatiens glandulifera Himalayan balsam. Bank of OW, N7.
Laburnum anagyroides common laburnum. K6, G7.
Lathyrus latifolius broad-leaved pea. By OW, L9.
Rosa arvensis field rose. Near Roding, M9.
R. canina dog rose. By Canal in N8 and in Bund, N7.
Prunus domestica subsp. *domestica* plum. Near OW, N6.
P. padus bird-cherry. Two trees by Roding, one by end of Canal, N8.
Cotoneaster sp. cotoneaster. A plant in the Bund, N7/8.
Crataegus sp. cf. *coccinioides* hawthorn. Two trees by OW in N7; one tree in N8; one M6.
Sorbus aucuparia rowan. Increasing number of seedlings throughout the Park.
Epilobium roseum small-flowered willow-herb. Disturbed ground near the Grotto in M7.
Myriophyllum spicatum spiked water-milfoil. In OW, L10.
Callitriche spp. water starwort. *C. ?intermedia* in SM, 17 and HP, L6. *C. ?platycarpa* in PP, L6.
Conopodium majus pignut. Grassland in J6, J7, M7.
Pimpinella saxifraga burnet saxifrage. East edge of Plain, M7.
Aegopodium podagraria ground elder. H6, 16.
Foeniculum vulgare fennel. Near Keeper's lodge, L7.
Angelica sp. angelica. Bund, N7.
Euphorbia helioscopia sun spurge. Disturbed ground, L7.
Polygonum arenastrum small-leaved knotgrass. East bank of Roding, 07.
Rumex sanguineus red-veined dock. By PP. M6.
R. palustris marsh dock. By SM in 17 and by HP in J6, K6.
Corylus avellana hazel. A coppiced tree by west side of OW, N7.
Quercus ilex holm oak. A sapling by PP, M6.
Q. petraea durmast oak. L7, M/N7.
Salix alba white willow. One tree north of pylon enclosure in bund, N7.
Syringa vulgaris lilac. A small tree in 16.

Ligustrum vulgare common privet. Bund N7/8.
Nymphoides peltata fringed water-lilly. Spreading rapidly in OW since *c*1979.
Myosotis arvensis common forget-me-not. Disturbed ground, L7.
Verbascum nigrum dark mullein. One plant in L7.
Veronica chamaedrys germander speedwell. K6, I6.
V. persica Buxbaum's speedwell. Disturbed ground, L7.
Lamium amplexicaule henbit. Bund, N7.
Galeopsis tetrahit common hemp-nettle. Chalet Wood, K7; disturbed ground, L7.
Galium saxatile heath bedstraw. Grassland, J6.
Viburnum opulus guelder rose. A shrub by OW, N7.
Lonicera periclymenum honeysuckle. H6, J6, L7.
Dipsacus fullonum wild teasel. Corner of SM, H16.
Bidens cernua nodding bur-marigold. Corner of SM, I6, I7; by OW, N6.
Gnaphalium uliginosum marsh cudweed. By HP, J6, K6; disturbed ground, L7.
Matricaria matricarioides pineapple weeed. By Northumberland Avenue, K6.
Tragopogon pratensis goat's-beard. Plain in M6/7, K/L7, J6.
Potamogeton trichoides hair-like pondweed. SM, I7.
P. pectinatus fennel-leaved pondweed. In River Roding.
Juncus conglomeratus compact rush. Apparently increasing in Warren Wood, K/L8.
Galanthus nivalis snowdrop. A few flowers in Grotto enclosure, N7.
Lemna trisulca ivy duckweed. In OW, N6.
Typha latifolia great reedmace. SM, I6; OW, N6.
Scirpus maritimus sea club-rush. HP, L6, K7.
Carex ovalis oval sedge. South-east corner of SM, I6.
Festuca ovina subsp. *tenuifolia* fine-leaved sheep's fescue. Plain, L7.
Agropyron repens couch. River Wood, L9; Bund, N7/8.
Deschampsia caespitosa tufted hair-grass. Bund, N7.
D. flexuosa wavy hair-grass. Plain, L7, M7.
Aira praecox early hair-grass. Plain, L6.
Agrostis gigantea black bent. Edge of HP, L6.
Alopecurus aequalis orange foxtail. Plentiful in HP, J6, K6, L6; also PP, L6.
A. geniculatus marsh foxtail. West end of HP, J7; bank of OW, L8.
Anthoxanthum odoratum sweet vernal-grass. By HP, J7.
Nardus stricta mat grass. Plain, K7, M7.

Part 2: Wanstead Flats and Bush Wood [South]

Aquilegia vulgaris columbine. WF. By City of London Cemetery wall, 01.
Rorippa islandica marsh yellowcress. BW. G8.
Alliaria petiolata garlic mustard. WF. By road-side in N1.
Viola sp. garden pansy. BW. Disturbed ground by Blake Hall Road, G7.
Sagina procumbens procumbent pearlwort. WF. West of spring, H5.
Montia perfoliata spring beauty. BW. F7.
Chenopodium album fat hen. BW. F7.
Althaea rosea hollyhock. BW. F7.
Geranium pyrenaicum mountain pearlwort. BW. Bushwood road-side, E6.
Genista anglica petty whin. WF. Two well-established plants in rough grassland, I4.
Rubus laciniatus cut-leaved bramble. BW and WF. E7/8; F6.
Geum urbanum herb bennet. BW. F6.
Prunus avium wild cherry. BW and WF. F7, G7, N1.
Cotoneaster horizontalis cotoneaster. BW. Some plants in G7.
Pyracantha coccinea firethorn. WF. A shrub in M3.
Sorbus aucuparia rowan. WF. Near Lake House Road in G5.
Pyrus communis pear. WF. By road-side in M2.
Epilobium roseum small-flowered willow-herb. BW. F6.
E. adenocaulon American willow-herb. WF. I3, F6.
Circaea lutetiana enchanter's nightshade. WF. Near Bush Wood in F6.
Euphorbia sp. cf. *cyparissias* spurge. WF. Well established by ditch on Manor Park Flats in M/N1.
Polygonum arenastrum small-leaved knotgrass. BW and WF. G7; J5.
P. amphibium amphibious bistort. BW. F8.
Syringa vulgaris lilac. VW. G8.
Symphytum officinale common comfrey. BW. F8.
Antirrhinum majus snapdragon. BW. Disturbed ground by Blake Hall Road in G7.
Symphoricarpos rivularis snowberry. WF. F3, M3.

Senecio vulgaris groundsel. WF. Various locations.
Tussilago farfara coltsfoot. WF. Roadside in M2.
Matricaria recutita scented mayweed. BW. G7.
M. matricarioides pineapple weed. BW. F6.
Chrysanthemum maximum Shasta daisy. BW. E8.
Sonchus asper prickly sow-thistle. BW. G7.
Ornithogalum umbellatum star-of-Bethlehem. WF. East edge of Centre Road, H5.
Juncus acutiflorus sharp-flowered rush. WF. Marshy land in H5.
Luzula campestris field wood-rush. WF. Grassland in M2.
Carex nigra common sedge. WF. near marshy area in M8.
Sieglingia decumbens heath grass. WF. Rough grassland in 14, near to *Genista anglica.*
Zerna erecta upright brome. H5, J2/3, L1.
Aira praecox early hair-grass. WF. West of spring in H5.
Anthoxanthum odoratum sweet vernal-grass. BW. F7.

Part 3: Leyton Flats and Bush Wood North

Dryopteris dilitata broad buckler fern. Near the spring in D13.
Ranunculus aquatilis water crowfoot. Small patches in D13.
R. sceleratus celery-leaved crowfoot. Common in muddy areas.
Armorica rusticana horse radish. Near Snaresbrook road in B14.
Cardamine flexuosa wavy bittercress. C12.
Rorippa amphibia greater yellowcress. Near James Lane in B11.
Erysimum cheiranthoides treacle mustard. By Forest Rise in A14.
Silene vulgaris bladder campion. In grassland near Hollybush Hill, E10.
Chenopodium bonus-henricus good King Henry. Roadside bank, C11.
Geranium robertianum herb robert. Near Hollybush Hill, E10.
Melilotus altissima tall melilot. By roadside in B14.
Trifolium dubium lesser yellow trefoil. By Whipps Cross Road-side.
Lathyrus tuberosus tuberous pea. Small patches in grass, B14.
Rubus laciniatus cut-leaved bramble. Near hospital entrance in A12.
Torillis japonica hedge parsley. By Snaresbrook Road in C14.
Rumex pulcher fiddle dock. One plant in B14.
Salix fragilis crack willow. By Eagle Pond.
Nymphoides peltata fringed water-lily. In West Pond, A13.
Calystegia sepium subsp. *sepium* hedge bindweed. Roadsides.
Glechoma hederacea ground ivy. By hospital wall in B11.
Lonicera periclymenum honeysuckle. One patch in A13.
Senecio jacobaea common ragwort. Grassland in E10.
Pulicaria dysenterica fleabane. One patch in grassland, E10.
Gnaphalium uliginosum marsh cudweed. South side of West Pond, A13.
Conyza canadensis Canadian fleabane. Roadsides.
Leontodon hispidus rough hawkbit. Grassland.
L. autumnalis autumn hawkbit. B14.
Sonchus asper prickly sow-thistle. Grassland in E10.
Hieracium spp. hawkweed. D13.
Taraxacum laevigatum agg. lesser dandelion. D14.
Lemna trisulca ivy duckweed. In West Pond, A13.
L. polyrhiza great duckweed. South side of Hollow Pond, C12.

TABLE 3. Species known to have been recorded in the vicinity of the study area, but not re-found in the same locality during the present survey.

Abbreviations

CC	Records held at Epping Forest Conservation Centre
EL	Record made by E. Lloyd
G	Record in Gibson (1862)
J	Record in Jermyn (1975)
JF	Specimen collected by Joseph Freeman of Stratford
KJA	Record made by K. J. Adams
L	Record in Lister (1941)
P	Record or specimen held at Passmore Edwards Museum, Stratford
PM	Record made by P. A. Moxey

Equisetum telmateia. Wanstead. G.
Asplenium ruta-muraria. Near Ilford. G.

Athyrium filix-femina. Wanstead Park. J.
Thelypteris limbosperma. Wanstead Heath. G.
Pinus nigra. Self-sown in the great pond at Snaresbrook. G.
Ranunculus aquatilis. Wanstead Park. L.
Brassica nigra. Bund area of Wanstead Park. CC (EL 1974)
Teesdalia nudicaulis. See G. 1862 for Forster's location. G.
Erysimum cheiranthoides. Wanstead Park. L.
Reseda luteola. Wanstead Park. L.
R. alba. Bank at Ilford. G.
Viola canina. P. (JF 1838)
Polygala vulgaris. P. (JF 1838)
Oxalis acetosella. Wanstead Park. L.
Trifolium dubium. Wanstead Park. L.
T. hybridum. Wanstead Park. L.
T. subterraneum. Wanstead Park. G.
Rubus caesius. Wanstead Park. L.
Rosa rubiginosa. Wanstead Park. G.
R. confertiflorus. Snaresbrook. J.
R. ulmifolius. Wanstead Park. L.
Potentilla sterilis. P. (JF 1838).
P. anserina. Glade area of Wanstead Park. CC (EL 1974).
P. anglica. Wanstead Park. L.; Bund and Glade area of Wanstead Park. CC (EL 1974).
Geum rivale. Bund area of Wanstead Park. CC (EL 1974).
Crataegus × *media*. Various locations in Forest. CC.
C. oxyacanthoides. Wanstead Park. L.
Sorbus torminalis. Wanstead Park. J. (This is almost certainly an incorrect record, and should probably be referred to an unidentified *Crataegus* sp. that occurs in the Park — see table 2).
Ribes rubrum. Wanstead Park. L.; CC (EL 1974).
R. uva-crispa. Wanstead Park. J.; CC (EL 1974).
Epilobium lanceolatum. Wanstead Park. L.
E. palustre. Wanstead Park. CC (EL 1974).
Myriophyllum alterniflorum. Wanstead Park. L.
Torilis japonica. Wanstead Park. L.
Apium nodiflorum var. *ochreatum*. Wanstead Park. J.
Sium latifolium. In Roding near Wanstead. G.
Oenanthe aquatica. Perch Pond in Wanstead Park prior to 1941. L.
Euphorbia peplus. Wanstead Park. L.
E. uralensis. Bush Wood, Friends graveyard. J.
Polygonum nodosum. Wanstead Park. L.
P. convolvulus. Wanstead Park. L.
Rumex tenuifolius. Wanstead Flats. J.
R. pulcher. Wanstead Flats. G.;P.
Urtica dioica var. *angustifolia*. Wimm. & Grab. Wanstead Park. L.
Humulus lupulus. Wanstead Park. L.
Salix aurita. Near Wanstead. G.
S. repens var. *fusca*. Near Wanstead Park G.
Erica tetralix. Wanstead. G.
Lysimachia nummularia. Wanstead Park. L.
Cuscuta epithymum. Near Wanstead Park. G.
Atropa bella-donna. Near Ilford. G.
Antirrhinum majus. Unknown location. P. (JF 183?).
Veronica officinalis. Unknown location. P. (JF 1837).
Euphrasia officinalis. Unknown location. P. (JF 1837).
Utricularia vulgaris. In pools near Whipps Cross. J.
Calamintha ascendens. Near Wanstead. G.
Prunella vulgaris. Wanstead Park. L.
Lamium maculatum. Whipps Cross. J.
Teucrium scorodonia. Wanstead Park. L.
Ajuga reptans. Unknown location. P. (JF 1838).
Littorella uniflora. Lake on the Forest near Wanstead Park. 1806 — not re-found by Gibson. G.
Galium palustre subsp. *palustre*. Private grounds (D14/15). CC. (KJA 1976).
Lonicera periclymenum. Private grounds (D14/15). CC (KJA/PM 1978)
Succisa pratensis. Wanstead Park. L.

Bidens cernua. Drying-up pool in Waterworks Wood. CC (1975).
Petasites hybridus. Wanstead Park. L.
Eupatorium cannabinum. Wanstead Park. L.
Anthemis cotula. Wanstead Park. L.
Chamaemelum nobile. Leytonstone. G.
Centaurea scabiosa. Reservoir Wood area of Wanstead Park. CC (EL 1974).
Leontodon autumnalis. Wanstead Park. L.
Hieracium Sect. *Sabauda.* Wanstead Park. L.
Baldellia ranunculoides. Near Wanstead. G.; Water at Wanstead House. P. (Lord Lister Herbarium 1845).
Damasonium alisma. Redbridge, near Wanstead. G.
Potamogeton gramineus. Lake near Wanstead. G.
P. friesii. Pond by 'The Rising Sun', 1954. J.
P. pusillus. Wanstead Park Lake in 1953. J.
P. obtusifolius. Wanstead Park lake, 1940. J.
Ruscus aculeatus. Wanstead. G.
Juncus acutiflorus. Bund area of Wanstead Park. CC (EL 1974).
Platanthera bifolia. Wanstead, rare. G.
Lemna gibba. Perch Pond in Wanstead Park prior to 1941. L.
Eleocharis acicularis. The Basin, Wanstead. G.
E. multicaulis. Lake near Wanstead. G.
Scirpus sylvaticus. Near Wanstead. G.
Schoenoplectus lacustris. By Roding, common. G.; Bund and Shoulder of Mutton Pond areas of Wanstead Park. CC (EL 1974).
Cyperus longus. Wanstead Flats, drainage ditch, *c.*1966. J.
Carex binervis. Wanstead. G.
C. demissa. Leytonstone near 'The Green Man'. J.
C. sylvatica. Glade area of Wanstead Park. CC (EL 1974).
C. pseudocyperus. Perch Pond in Wanstead Park prior to 1941.
C. pendula. Bund area of Wanstead Park. CC (EL 1974).
C. acuta. Wanstead Park. L.
C. remota. Wantead Park. L.
Phragmites communis. Heronry Pond in Wanstead Park. CC (EL 1974).
Catabrosa aquatica. Wanstead. G.
Festuca pratensis. Wanstead Park. L.
F. gigantea. Wanstead Park. L.
F. ovina subsp. *ovina.* Wanstead Park. L.
Poa trivialis var. *parviflora* Parn. Wanstead Park. L.
Brachypodium sylvaticum. Wanstead Park. L.
Avena fatua. Wanstead Park. L.
Agrostis stolonifera. Wanstead Park. L.
Alopecurus aequalis. Private grounds (D14/D15). CC (KJA/PM 1978).
Phalaris arundinacea. Private grounds (D14/D15). CC (KJA/PM 1978).

Errata

Part 1: *Lond. Nat.* **59,** 1980.

p.14. Sixth line from bottom of page should read 'grey poplar *Populus canescens* is also present and regenerates readily'.
p.17. For *R. palustris* read *R. islandica.*
p.19. '*Populus alba* white poplar' should read '*Populus canescens* grey poplar'.
p.20. For *C. cappillaris* read *C. capillaris.* For *N. poeticus* read *N. majalis.*

Part 2: *Lond. Nat.* **60,** 1981.

p.16. The record for *Lysimachia vulgaris* may have been an incorrect identification of *L. punctata.*
p.17. For Buscbaum's speedwell read Buxbaum's speedwell.
p.18. For *F. tenuifolia* read *F. ovina* subsp. *tenuifolia.*

The River Wandle: Studies on the Distribution of Aquatic Plants

by S. M. PRICE*† and J. H. PRICE**

Summary

The Wandle, a short but important tributary of the Thames traversing areas of dense population, has a long history of industrial involvement. Other workers have already demonstrated marked improvement in water conditions over recent years. From general surveys along the river and more detailed transects across the water-course at eight stations, the distributions of principal benthic and some planktonic algal constituents of the flora are presented; aquatic phanerograms are also included. Some characteristics of seasonal variation are examined. The relationships of the distribution patterns with the nature and distribution of past and present pollutant inflow are considered, as is the correlation of these relationships with those shown previously for the invertebrate fauna. An attempt is made to evaluate the overall significance of these data as a basis for assessment of present conditions and trends in the river.

Introduction

The use of organisms as indicators of particular environmental conditions is well established in ecological studies, water quality measurement, and biological monitoring; animals, especially, have been employed in aquatic situations (Hellawell 1978). Titmus (1981) outlined some criticisms of the 'indicator species' approach for lowland rivers and discussed overcoming limitations in the alternative approach through simple community structural diversity measures. Quantitative assessment by biological methods of perturbations (human and otherwise) of aquatic systems still leaves much to be desired (Lawrence and Harris 1979). Using *Limnodrilus* and *Tubifex* (tubificid worms), these authors attempted to improve grading of species-relative pollution-tolerance through contingency table analyses involving site water parameters, species density, and dominance values.

This is more sophisticated than most benthic macrophyte utilisation as freshwater environmental indicators (but see Whitton 1970, 1979; Holmes and Whitton 1981; Haslam and Wolseley 1981). Benthic macroalgae have more recently been used to demonstrate the effects of pollution (Whitton 1975; Wilhm 1975), its cessation (Harding 1980), or reduction (Harding *et al.* 1981), but much of the previous demonstration took the form of inference rather than quantitative treatment. Whitton (1975) presented reasons why lotic (rapid water) benthic macroalgae hitherto lacked the detailed floristic accounts or reviews that exist for lake and reservoir macroalgae. Lesser past interest by water industry and, predominantly, special lotic habitat features (floods/desiccation being more rapid and less predictable) are most important. Quantitative studies of benthic macroalgae in streams therefore require consistent and sustained effort (Holmes and Whitton 1981), more even than do planktonic studies in the same habitat (Whitton 1979). There is less theoretical framework and less intellectual appeal than in phytoplankton of well-known lakes.

Available theoretical framework for temperate lotic habitats indicates good representation of aquatic phanerogams; freshwater benthic Rhodophyta; Ulot-

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†Includes data derived from a project carried out by the first author in partial fulfilment of the requirements for the CNAA Postgraduate Diploma in Air and Water Pollution Control, Polytechnics of Middlesex and Central London, 1980.

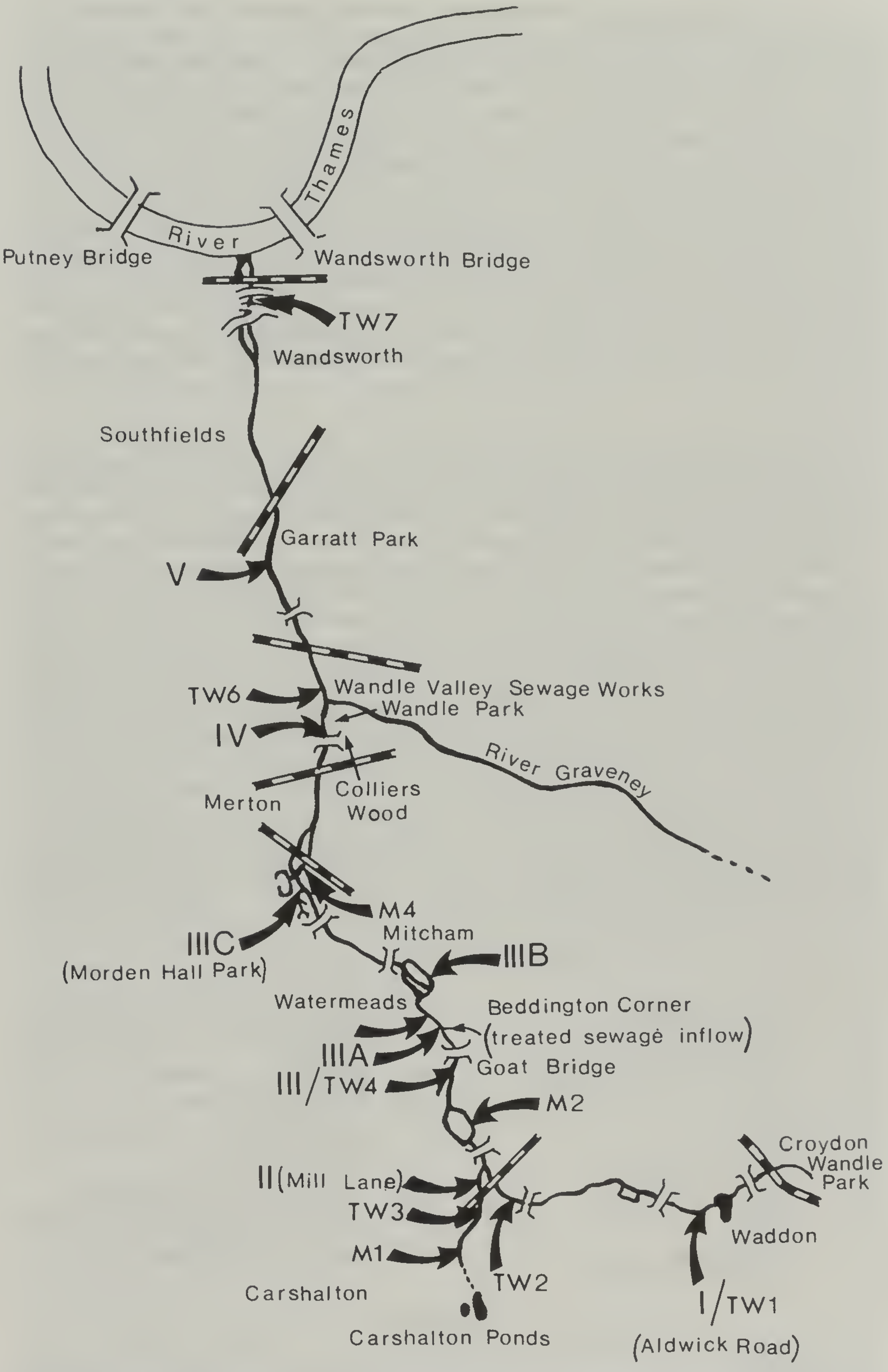

FIG. 1. River Wandle from sources to the Thames. Shows sampling points: I-V (Stations I-V); TW 1-7 (Thames Water sampling points); M1-4 (McCrow sampling points).

richales and Cladophorales (Chlorophyta). The macrophytes may, according to tolerance, be attached to all/any substrate from firm rock, stabilized pebbles/ smaller rocks, firm artificial substrata (all epilithic); through silt (epipelic); to other benthic (especially plant) macroorganisms (epiphytic). Epilithic and epipelic organisms are here grouped as epibenthic, simplified to benthic; epiphytic organisms include the periphyton ('Aufwuchs'), plants closely associated with (e.g., habitually intertwined) but not actually attached to surfaces of larger plants. Epizoic plants have been discounted because of comparative rarity here. Phytoplankton were not studied in detail, but it should be stressed that benthic algae (especially diatoms) or fragments of them are in lotic conditions often washed from normal microhabitats into suspension, thus joining the plankton (Butcher 1940; Blum 1956; Hynes 1970; Marker and Gunn, 1977; Swale 1964). Marked seasonal variation in species composition and biomass of epilithic algae in, e.g., chalk streams (Marker 1976*a*), should therefore be reflected in the algal component of suspended solids (Marker and Gunn 1977). Generalized algal seasonal sequences are summarized in Hynes (1970) and Holmes and Whitton (1981).

Nature, size, surface texture and chemistry of the substrata; current speed; temperature; light climate; water chemistry; competition; succession, and other biological phenomena, all affect presence, luxuriance, density, distribution and growth-form of the lotic benthic macrovegetation. Here, short-term demonstration of *locational* effects of human-induced environmental pollution on benthic macroflora of the Wandle is the primary aim. The term 'benthic macro-flora' is purposely not group-specific. Even where the 'host' substrate (plant) is offering merely an effectively inert surface for colonization by epiphytes (Cattaneo and Kalff 1979), there is joint (augmented, altered, or restricted) reaction to environment on mechanical and physical bases and it is not possible to consider component species in isolation. Additionally, available background data usually take more account of phanerogams than of algal epiphytes or epilithic associates. Phanerogams, it appears, (being often large and identifiable from bridges; Haslam 1978) are often both better and more utilitarian indicators (Haslam and Wolseley 1981). Even the biomass of algae in southern hard-water streams is of secondary importance (Marker 1976*b*), although smaller river or stream systems tend to have a proportionally larger contribution by attached algae to autotrophic production than do larger systems (Wetzel 1975). Neither separate consideration of algae and other macrophytes, nor complete demonstration of temporal variations, has been possible in this survey.

Key to general symbols: all figures and tables

Al	algae
An	*Apium nodiflorum*
As	*Agrostis stolonifera*
B	benthic or benthos
Bm	*Batrachospermum moniliforme*
Br	Bryophyta
Br*	Bryophyta and *Cladophora glomerata* (Fig. 6A,C)
Cg	*Cladophora glomerata*
Cp	*Callitriche platycarpa*
E	epiphytic or epiphyton, including periphyton
Ec	*Elodea canadensis*
Fa	*Fontinalis antipyretica*
Gm	*Glyceria maxima*
Ip	*Iris pseudacorus*
M	all macrophytes, *Ranunculus fluitans* dominant
P	planktonic or plankton
Pc	*Potamogeton crispus*
Ph	phanerogams
R	*Ranunculus* spp.
Rf	*Ranunculus fluitans*
Rna	*Rorippa nasturtium-aquaticum*
Rpc	narrow-leaved *Ranunculus penicillatus* vars *penicillatus* and *calcareus*
Zp	*Zannichellia palustris*

The River

(a) General

The Wandle (Surrey and London) is a small, short (*c.* 17 km), right (south) bank tributary of the Thames (Figure 1). There are problems of access in places

(McCrow 1974), but the water-course has delimitable points of inflow of potential pollutants into an otherwise high quality stream arising almost wholly from a chalk aquifer (Stevenson 1809; Giuseppi 1910; Hobson 1924; McCrow 1974; Monk and Rice 1976; Jennings 1977; Aston and Andrews 1978). There is a long history of human settlement and exploitation locally; this has resulted in much historical comment on the area, its drainage patterns, its surface waters, and the nature/levels of pollution (e.g. Camden 1586 *et seq.;* Camden and Gough 1789; Stevenson 1809; Braithwaite 1861; Ruskin 1866; Giuseppi 1908, 1910; Hobson 1924; Barton 1962, 1982; McCrow 1974; Twilley and Wilks 1974; Aston *et al.* 1979). Considerable physical environmental information exists on both catchment area and water quality (McCrow 1974; Jennings 1977; Aston and Andrews 1978; Aston *et al.* 1979; Dart 1979), with data on the effects of pollution inflow on the fauna (McCrow 1974; Aston and Andrews 1978; Aston *et al.* 1979). Overall patterns of water-catchment geography and hydrogeology of Surrey, especially of the chalk of the London Basin, have been covered by Fish *et al.* (1975) and in Anon. (1972).

The Wandle arises amongst springs that emerge where the chalk dips beneath the permeable Lower London Tertiaries, at a level of about 60 m, near Croydon (Croydon Arm). The Carshalton Arm arises from Carshalton Ponds, although the hitherto perennial supplying springs are now intermittent and flow is artificially maintained by re-circulation at a 10×10^6 litres/day daily minimum. The Arms join at Hackbridge; thence to the outfall near Wandsworth Bridge are received one natural tributary (River Graveney) and one artificial tributary (the very significant — above 70% of total flow — and powerful treated-sewage effluent from Beddington Sewage Works, entering at Beddington Corner). The Wandle has a comparatively great (but not uniform) drop of about 40 m in 17 km, hence its long history of use as a power-source. The upper section is steepest, the fall being *c.* 7.3 m/mile in the Croydon Arm downstream to Beddington Park; thence to Mitcham Bridge, it is more a gentle 5.03 m/mile, decreasing markedly to the outfall. Steep artificial falls induced in the upper reaches during the water-mill eras in many cases remain, supplemented by more modern weirs such as that at Vinyl Products factory entrance, Mill Lane (station II area).

Flow-rates are presented in Aston *et al.* (1979); McCrow (1974) noted considerable day-to-day and time-to-time fluctuations. Current-flow affects turbidity, concentration of pollutants and, *inter alia,* attachment and growth-form of plants. Benthic macroalgae, especially, are affected where plants have attached to fragments of small size only imperfectly embedded in an otherwise mobile substratum, particularly where individual plants have outgrown the anchoring capacity of the fragments. Some evidence of drifting material so originating was seen in the present survey, but its significance to the river ecosystem is not clear. McCrow's (1974) figures included 12 m/min. for The Grove (her point 1); 20 m/min. for Hackbridge (point 2); 10 m/min. for The Goat (point 3); 20 m/min. for Morden Hall (point 4). Currently, The Goat figure is likely to be far exceeded, due to speed and volume of outflow from Beddington Sewage Works, reversing the relationships between it and positions above (Hackbridge) and below (Morden Hall).

(b) Water Quality

Characteristics potentially affecting benthic macrovegetation include:

(i) Temperature

Air and water (directly above substrate) temperatures were presented by McCrow (1974). Thames Water Statistics (e.g., for 1978, Dart 1979) give values for water only. At Goat Bridge (TQ 279669) and Watermeads (TQ 275676), 23 samples indicated respectively (7-)11(-17)°C and (7-)13(-19)°C (= min./mean/

max. for 1977-78). Causeway (TQ 256748), near the outfall, gave (6-)12(-20)°C from 52 samples. Some recent water temperatures (°C) are presented in Table 1. Levels indicated could make some local difference to growth rates, growth periodicity and fruiting of macrophytes and macroalgae, but are unlikely to cause other than normal seasonal loss/gain of species or of aerial parts of individuals.

TABLE 1. Temperature (°C) in 1979: upper 15 cm of Wandle flow.

Station	I		II		III		IV		V	
Date	*Air*	*Water*	*Air*	*Water*	*Air*	*Water*	*Air*	*Water*	*Air*	*Water*
1 Aug.	23	15	24	15	24.5	16.5	–	–	–	–
23 Aug.	–	–	–	–	–	–	15	17	15	15.5
30 Aug.	14.5	12.5	15.5	11.5	20	13	20	17	20	18
5 Sept.	18.5	13.5	20	13	22	15	23	18.5	23	17.5

(ii) pH

Dart (1979) and McCrow (1974) indicated values, for locations at or near present stations, within the range of (6.9-) 7.3-7.8 (-8.3); these more common values would not affect presence/absence of particular benthic macroalgae.

(iii) Chemical and biological quality

Records from 1970-77 and 1978 were used (Aston *et al.* 1979; Dart 1979) to arrange waters according to 1976 National Water Council Working Party standard classes 1A, 1B, 2, 3, 4, and X. 1A (high quality waters giving potable supply and supporting game fisheries) decreases to 4 (grossly polluted), with X being insignificant streams. Clyde River Purification Board (Ross 1977) also developed a more sensitive classification (including suspended solids, ammoniacal nitrogen, BOD, DO) to give a quality scale 0 (low) to 10 (high). Biological index (based on macro-invertebrates of the river bed) was expressed in Trent Biotic Index (Woodiwiss 1964). Although the 1978 figures (Dart 1979) appeared on a more restricted station basis than for the 1970-77 period (Aston *et al.* 1979), there is direct comparability for all three (Goat Bridge; Watermeads; Causeway) later stations since Causeway is much the same as the earlier location 7. Although BOD downstream of Beddington Sewage Works outfall remained much higher than upstream, general maintenance of the amelioration shown in the 1970-77 figures continued through 1978.

(iv) Turbidity

Turbidity importance in the Wandle has been implied but not directly debated in publications. McCrow (1974) made some comments, such as '....water ....clear ....bed ....seen quite distinctly....' (her station 1); '....seen reasonably clearly....' (2); '....water ....so turbid ....bed ....cannot be seen....' (The Goat and Ravensbury Park); '....water is turbid, often completely obscuring the river-bed....' (4; Morden Hall). Assessment *via* a turbidity/penetrability ratio is subjectively attempted here (Table 2). It should be stressed that considerable diurnal or longer period fluctuation exists and it has been possible to construct only a general notion of this within the figures presented. There would, for instance, be occasions when ratios of all stations I-IIIB inclusive would be little different; on others, differences would be considerable, from the extremes of 0 turbidity to 30 turbidity.

TABLE 2. Turbidity/penetrability ratio assessments.

Station	*Ratios and comments*
I. II. III.	At worst 10 turbidity: 90 penetrability — this is the most consistently occurring ratio. Occasionally about 0-5 turbidity: 100-95 penetrability.
IIIA.	Speed of flow causes local surface-rippling and bed-stirring, sometimes reducing otherwise highish clarity; this is always likely since Beddington inflow is strong, rapid and consistent. Usual ratio 30 turbidity: 70 penetrability.
IIIB/C.	Slightly less turbid than IIIA; lesser surface-rippling reduces in part the turbidity/reflectance. 20 turbidity: 80 penetrability.
IV.	River occasionally like a thick paste (paper waste), with fastish flow due to effluent strength — principally noted in late afternoon. Estimated ratio then 100 turbidity: 0 penetrability. At other times, water is clear, flow slower, without direct effluent, bottom becoming visible beneath *c*. 60 cm of water; no determination of plants present possible without raising macrophytes to air interface. Ratio then 50 turbidity: 50 penetrability.
V.	Less thick than at IV, even when very turbid from combined tannery and paper-mill effluents — 80 turbidity: 20 penetrability. When clearer and with less, or no, outfall — 50 turbidity: 50 penetrability.

(c) Sources and nature of pollution; stations selected

The worst of the industrial, and especially organic (sewage), pollution in the Wandle seems to have been generated over the period from about 1850 onwards, although the general increase paralleled the timing of the Industrial Revolution. By 1910, Giuseppi was commenting that over the preceding 50 years, the Wandle had been scheduled by Act of Parliament as a main sewer for London. McCrow's (1974) summary was similar in content: '. . . The pollution of the Wandle must be controlled more strictly in an attempt to restore the condition of the river.' Nevertheless, she noted encouraging signs that positive steps were being taken, a general trend further described in Aston and Andrews (1978) and in Aston *et al.* (1979). Although McCrow was concerned only with the upper 6.5 km of the river, below which there is more industrial usage (including additional paper-mills and leather works), the spectrum of industrial involvement noted remains largely representative of today. Detailed circumstances differ, but there are interesting comparisons with progress and changes in pollution in the River Etherow (Harding *et al.* 1981).

Some Wandle valley catchment is still the general ground-water off-run. This automatically carries human influence, implied by 'general urban run-off'. There is much of this at Aldwick Road (present Station I) and (especially) along Mill Lane (Station II) and at Hackbridge (Stations II/III), where the artificially-reinforced banks are set at intervals with pipes through which drain the local surface and superficial waters. The effects of whatever pollutants this surface water contains are generally spread and here they have been largely discounted, although clearly heavy rains or sudden thaws may both dilute and localize the effects.

Station I (Waddon: Aldwick Road, TQ 307652, Croydon Arm) is a stretch with reinforced wooden/concrete banking at the end of Aldwick Road; the subject of faunal and water quality analyses already by Thames Water staff, it was visited in August/September 1979 and in January 1980. Investigation of the effects on the flora of intermittent and unidentified pollution that occurs in culvert beneath Croydon (Aston *et al.* 1979; Aston and Andrews 1978) was included.

Station II (Mill Lane, stretch between TQ 282650 and TQ 282654, Carshalton Arm) has stabilized (but not artificial, save in the old mill-race near Mill Lane

Works, Butter Lane) banking and extends from BP/Mill Works, south of Butter Lane, to the footbridge at Strawberry Lane. The transect sampling was very near Strawberry Lane, TQ 282654. Visits were as for Station I. Mill Lane and the adjacent area is named for the water-mills that were present along this stretch; a large chemical works (BP) and synthetic resin works (Vinyl Products) now occupy the situation, neither being dependent on river power and neither producing obviously contaminatory effluent, save for heated coolant waters through outfall pipes from the factory areas.

Station III (Goat Bridge, TQ 279669) is downstream of the confluence between the two Arms, at the junction of the drying channel that trends towards Wandle Valley Hospital, on the south side of the road bridge. Observations were made along the stretch to just downstream of the strong inflow from Beddington Sewage Works (see IIIA, below). The river here is largely in concrete-lined channels, or culvert under the road, orientated alongside the line of Water Mead Lane. Visits were as for Station I. Up-stream of Goat Bridge lies the Wandle Valley Trading Estate, present major outfall apparently coolant water. Discharge at high temperature causes local variations (up to several °C) both in time (diurnal and seasonal effects) and space (discharge pattern and the reaction of the river water and its flow). Although this might affect the distribution of, say, fish, the pattern is well within the tolerance limits of algae and phanerogams present. Local distribution and luxuriance in growth of the plants may show some reactions, within restricted distance of the outfall (Swale 1964). Information on any other possible outfall constitutents was not available; the wastes usual to the electrical engineering, light engineering, plastic-coating, sheet-metal working, stove-enamelling, rubber and leather manufacture, in the area, seem likely to be low or absent, in view of figures in Aston *et al.* (1979) and Dart (1979).

Discharge from Beddington Sewage Works (**Station IIIA**, below the Outfall, TQ 278671) of treated effluent is very fast and strong. The channel along the stretch is concrete-lined on the west side, where the fast flow is deep (*c.* 1 m or a little less). Visits were made in January 1980 and earlier. The effluent comprises 70% or more of the total average river flow. Aston *et al.* (1979) indicated a steady invertebrate biotic index of 4 below the effluent discharge; effects of the discharge on suspended solids, ammonia, BOD and DO are also clear from their paper. BOD values indicate dramatic improvement between 1970 and 1977. By the common pollution classification for Great Britain (Maitland 1978), BODs of 0-1 mg/l are 'very clean'; 1-2.5, 'clean'; 2.5-4, 'fairly clean'; 4-6, 'doubtful'; 6-10, 'poor'; 10-15, 'bad'; 15-20, 'very bad'; 20+, 'extremely bad'. Croydon Arm upper reaches therefore improved from doubtful/poor (5.7) in 1970 to clean (1.9) in 1977. Carshalton Arm became clean (2.0) from being poor (8.7). Goat Bridge became clean (2.0) from being doubtful/poor (6.0). Beddington Sewage Works effluent changed to merely poor (6.2) from being a complete disaster (29.8); Watermeads achieved a similar change to doubtful (5.6) from being extremely bad (23.5). The Wandle Valley Sewage Works discharge, still functional in 1970, but not by 1977, was almost unimaginable at 34.6, but dropped to nearly fairly clean category (4.1). Slightly up-stream of the final river outfall was still 18.1 in 1970 (very bad) but ameliorated to 3.6 (fairly clean). Dart (1977) updated progress for Goat Bridge, Watermeads and Causeway (Outfall). The mean of 1.7 in a range of 3.5 to 0.4 indicates fairly clean to very clean, for Goat Bridge; Watermeads changed from 5.6 (doubtful) to 4.2 (nearly fairly clean), in the range 8.4 to 1.2; Causeway became 5.4 (doubtful) from 3.6 (fairly clean), in a range of 13.8 (bad) to 1.7 (clean). Storm flooding or similar presumably affected the worst of the Causeway readings; possibly back-pressure from the Thames was also involved.

Downstream water-quality is also affected by other works effluents. Before the Watermeads (**Station IIIB**) there is a further trading estate. The north-east side of the Watermeads (London Road, Mitcham, TQ 275676) was mainly established as a station for collection of plankton, drift macroalgae and drift phanerogams; previously a water-cress bed area, there is a fast flow around a curve. Visits were made in August/September 1979. Morden Hall Park (The Lodge), **Station IIIC**, was visited later, in early 1980. This 100 m-long area on either side of the road bridge (TQ 262685) was for examination of macrophyte flora progress. The draining outflow channel and artificial wall to the park had luxuriant macroalgal flora of few species (e.g., *Cladophora glomerata)*; very small amounts of *Ranunculus fluitans* were attached on the north of the road bridge.

Station IV (Wandle Park) lies near the junction of Wandle Bank and High Street, Colliers Wood, just north of the latter, at TQ 267702. This, the first access point after the outfall of clearly contaminatory paper-mill effluent, suffers heavy intermittent (usually afternoon) loads of suspended solid. The latter are sometimes associated with a rapid flow rate at discharge but the water becomes sluggish when the associated turbidity clears somewhat as the discharge slows. The suspended solids must surely contain starch, dextrin and organic (cellulose) paper-pulp; the latter, especially, was detected in large quantity during August/ September, 1979. Paper-mill effluent not infrequently contains free chlorine, although it is not known to be the case here. The area of the station is stabilized by bridge-walling. Oil and grease on the river surface commencing just before Garratt Park may derive from escape in effluent of the slubbing (wool processing) works near there.

At Garratt Park itself (Summertown, TQ 259723) lies **Station V**, near the disused sewage works and large functional allotments area. Waters here are very turbid, oily and greasy, carrying a heavy load of suspended solids. The centre channel is fairly deep (*c*. 75 cm) and the retaining banks muddy. The allotments area conceivably releases variable amounts of herbicides, insecticides and fertilizers into the river from surface off-run during heavy precipitation. The station area has been subjected intermittently to detectable, probably accidental, discharges of lubricating and other oils from nearby engineering works and garages. General surface downwash of hydrocarbons from similar sources could have been contributory under storm conditions to the high maximum readings (see above, under Station IIIA) in 1978 at the Causeway area. Garratt Park area also has outfall from various small factories, the paper-mill, and leather works. Station V represents the first point of access after the inflow of the leather factory effluent.

The Organisms

(a) General

Plant macro-species present in significant amounts or with critical distribution are apparently few; indicator organisms were therefore not selected prior to recording, on grounds that this could at the outset introduce results biased by neglect of particular taxa. All detected phanerogams and benthic macroalgae were followed through all stations, and the only reservations rest with practicability of recognition and identification in reasonable time-scale. Organisms in Table 3, which is largely self-explanatory, are therefore all identifiable under optical magnification of at most ×100. Determinations were based on specialist literature and on comparison with available herbarium or spirit material. Phanerogams were confirmed by Messrs E. W. Groves and G. A. Matthews and bryophytes by Dr A. J. Harrington (all BM(NH)). Literature employed included Haslam 1978; Haslam and Wolseley 1981; Haslam, Sinker and Wolseley 1975; Lousley 1976; Salmon and Brewer 1863; Salmon and Pearsall 1931; Watson and Richards 1968. Benthic macroalgae, diatoms and plankton were identified by use of Belcher 1959; Bourrelly 1966, 1968, 1970; Douglas 1958; van den Hoek 1963; Israelson 1942; Sirodot 1884; Smith 1950; West and Fritsch 1927 and Whitton *et al.* 1978. Extant material was used in subsequent confirmation.

TABLE 3. Distribution by stations of species detected, life states, and (by symbol ⊗) outstanding characteristics of frequency/rarity. The latter are (for the algae) further detailed in Table 5. For full explanation of the basis, see text.

		Station I			Station II			Station III			Station IV			Station V		
		B	E	P	B	E	P	B	E	P	B	E	P	B	E	P
Cryptogams																
Cyanophyta (Cyanobacteria)	*Chamaesiphon incrustans* Grunow in Rabenhorst					x										
	Coelosphaerium kuetzingianum Naegeli								x							
	Nostoc parmelioides Kützing								x							
	Oscillatoria Vaucher (spp.)	x	x	x	x				x		⊗	⊗			x	
	Phormidium Kützing (sp.)											x				
	Rivularia Roth (sp.)	⊗			x			x								
	Spirulina Turpin (sp.)								x							
Rhodophyta	*Batrachospermum moniliforme* Roth	⊗		x												
	Chantransia-stage *(Batr. mon.)*	x			x				x							
	**Pseudochantransia* sp. *sensu* Israelson	⊗			x			x								
Euglenophyta	*Euglena* Ehrenberg (sp.)	x														
Xanthophyta	*Tribonema* Derbès et Solier (sp.)								x			x				
	***Vaucheria* De Candolle (sp.)	⊗	x					x	x					x	x	
Bacillariophyta	*Bacillaria paradoxa* Gmelin						x			⊗			x			
	Diatoma De Candolle (sp.)	x	x					x								
	Fragilaria Lyngbye (sp.)		x						x	x						
	Meridion circulare C. A. Ag.								x							
	Melosira C. A. Ag. (2 spp.)	x	x	⊗				x	⊗	⊗		x	x			
	Synedra Ehrenberg (sp.)		x	x			x			x						
	Tabellaria fenestrata (Lyngbye) Kützing		x				x	x	x							
Chlorophyta	*Cladophora glomerata* (L.) Kütz.	⊗	⊗		x	x		⊗	⊗	x	x	x		⊗	x	x
	Closterium Nitzsch (3 spp.)								x	⊗						x
	Coelastrum Naegeli (sp.)									x						
	Cosmarium Corda (2 spp.)									x		x				
	Dictyosphaerium pulchellum Wood								x	x						
	Eudorina elegans Ehrenberg									x						
	Gonium pectorale O. F. Müller									x						
	Microspora Thuret (sp.)		x													
	Netrium (Naegeli) Itzigsohn et Rothe									x						
	Oedogonium Link (sp.)							x	x	x	x					
	Pithophora oedogonia (Mont.) Wittrock		⊗													
	Spirogyra Kützing (2 spp.)	x	x	⊗			⊗		⊗	⊗						⊗
	Stigeoclonium Kützing (sp.)	x	x						x		⊗	⊗	x	x		
	Ulothrix Kützing (sp.)	x	x	x					x	x		x		x		x
	Zygnema C. A. Agardh (sp.)								x							

Notes
* = Morphology more distinctly globular/crustose than Chantransia.
** = Sterile *Vaucheria* only found.
*** = Includes *Ranunculus fluitans* Lamour. and *Ranunculus penicillatus* var. *penicillatus* and var. *calcareus* (R. W. Butcher) C. D. K. Cook.

		Station I			Station II			Station III			Station IV			Station V		
		B	E	P	B	E	P	B	E	P	B	E	P	B	E	P
Bryophyta																
Hepaticae	*Marchantia polymorpha* L.	x									x			x		
Musci	*Amblystegium riparium* (Hedwig) Br. Eur.	x			x			x			x			x		
	Bryum argenteum Hedwig							x								
	Ceratodon purpureus (Hedwig) Brid.							x								
	Fontinalis antipyretica Hedwig							x								
	Physcomitrium pyriforme (Hedwig) Brid.													x		
Phanerogams	*Agrostis stolonifera* L.	x														
	Apium nodiflorum (L.) Lag.				x			x								
	Callitriche platycarpa Kützing	x			x			x								
	Elodea canadensis Michx.				x			x								
	Glyceria maxima (Hartm.) Holmberg				x			x								
	Iris pseudacorus L.				x											
	Potamogeton crispus L.				x			x								
	****Ranunculus* spp.							x			x					
	Rorippa nasturtium-aquaticum (L.) Hayek				x			x								
	Zannichellia palustris L.				x			x								

There are very few published or known unpublished records of plants available on which to base assessment of comparative effects over time on the aquatic flora of the Wandle. Some general comment on the flora or on particular species is presented in Hobson (1924); McCrow (1974); Aston and Andrews (1978); Lousley (1976); Salmon and Brewer (1863) and Salmon and Pearsall (1931). Virtually none of this comment concerns benthic macroalgae and none at all is usefully distributional or quantitative. Even the freshwater algal lists in West and West (1902; 1920) contain no records for the Wandle. Some unpublished phanerogam records have been located in J. E. Dandy's *Potamogeton Index* (BM) and others in the British Herbarium at the BM. A collation of available background appears as Table 4; these data are clearly insufficient for significant conclusion on long-term changes.

(b) Sampling; frequency/abundance/cover estimation

Macrophytes (phanerogams; bryophytes; *Cladophora* in recognisable macro-growths — all largely epilithic).

Blum (1957) utilised transects *across* rivers, using a marked rope and reading in detail every alternate decimetre. Whitton and Buckmaster (1970) and Holmes *et al.* (1972) employed transects running *along* whole rivers (Wear; Tyne). Such transects would have been highly desirable quantitatively to reveal both pattern and process here, but were impracticable through time and logistic constraints. Holmes and Whitton (1981) and Harding *et al.* (1981) more recently used 10 m lengths (reaches) along the rivers Tees and Etherow. The method here adopted was cross-river transects, with additional general observations along variable stretches in the vicinity. Sampling along and around the transect was regulated on a time basis (45 mins per transect visit), except in a few cases where excessive complexity or river width required more time for data comparability. After a rapid initial recording as a belt-transect, patches of dense flora were examined in detail; collections were made from them by means of 10 0.33 m^2 quadrats per

Table 4. Previous records detected: Wandle aquatic flora.

Name	*Source*	*Details*
Callitriche platycarpa	McCrow (1974)	Flourishing growth, in numerous places at 'The Grove' (TQ 280648), Carshalton Ponds.
	McCrow (1974)	One or two stems in places, Hackbridge (TQ 281659).
Elodea nuttallii	Aston and Andrews (1978)	Goat Bridge site (TQ 279669), 1976 and 1977: recently introduced from the Netherlands, perhaps to become a nuisance equal to *E. canadensis*. [Taxonomic status in some doubt; similar doubt if the form originally identified for U.K. is actually the same as that to which the name is applied elsewhere].
Glyceria maxima	Lousley (1976)	Frequent along the Wandle.
Lemna minor	McCrow (1974)	Slow stretches near the bank, flourishing growth in numerous places at "The Grove", Carshalton Ponds.
Nuphar lutea (L.) Sm.	Hobson (1924)	In still water as at Waddon mill-pond.
Phragmites communis Trin. (*P.australis* (cav.) Trim. ex Steud.)	Hobson (1924)	Growing far out into the stream in many places where the flow was sluggish, marsh and river merging.
Potamogeton crispus	Dandy, *Potamogeton Index*.	R. Wandle, near Waddon Mill, Croydon, 29.vii.1867, A. Bennett.
Potamogeton densus	Dandy, *Potamogeton Index*.	R. Wandle, at Merton, vi. 1852, W. W. Saunders.
		At Mitcham, 11.v.1884, J. Fraser.
		At Mitcham, viii. 1885, A. Bennett.
		At Merton, 20.vii.1894, J. H. Morgan.
		Ditch by R. Wandle, Hackbridge, 15.viii.1868, A. Bennett.
Potamogeton pectinatus L.	Salmon and Brewer (1863)	In the Wandle near Merton Abbey, W. F. Saunders.
Ranunculus fluitans	Salmon and Brewer (1863)	In the Wandle at Merton Abbey, W. F. Saunders.
	Hobson (1924)	Below the bridge at Butter Hill, just before the Wandle enters the grounds of Shepley House, in the rapid flow there the river is full of long leaves.
	Lousley (1976)	In the Wandle . . . Watermeads, J. E. L.
Ranunculus penicillatus Dumort. var. *penicillatus* (Dumort.) Bab.	Lousley (1976)	Old cress-beds, Hackbridge, 1957.
Ranunculus sp.	Hobson (1924)	Submerged leaves colouring green the clear water at Carshalton east pond.
Rorippa nasturtium-aquaticum	McCrow (1974)	Flourishing Growth in numerous places at "The Grove", Carshalton Ponds.
Scirpus lacustris (*Schoenoplectus lacustris* (L.) Palla)	Hobson (1924)	Growing far out into the stream in many places where the flow was sluggish, marsh and river merging.
Spirogyra	McCrow (1974)	Included in 'various algae' found at "The Grove".
Typha latifolia L.	Hobson (1924)	Growing far out into the stream in many places where the flow was sluggish, marsh and river merging.
Zannichellia	Hobson (1924)	River full of long leaves, location as for *Ranunculus fluitans* at Butter Hill.

transect, laid at intervals subjectively chosen to include the patches of dense plant cover. At narrower spots, the quadrats were enough to cover the whole width of the river. Estimates of surface cover and frequency were then made, and distributions mapped.

Microphytes (algae other than *Cladophora* in recognisable macro-growth — planktonic, benthic, epiphytic).

Collection pattern for non-planktonic forms was as detailed under macrophytes, since all material was collected together. In the laboratory, only organisms locatable and identifiable under ×100 magnification were recorded, on grounds of time. Of the abundant diatoms collected, only colonial forms or simple aggregations were analyzed and data presented here. Planktonic material was collected by trailing a plankton net in individual major and lesser flow areas associated with stations for a set 15 mins period per collecting point. The same ×100 limitation was applied in laboratory study.

Planktonic: three microscope preparations were taken from each plankton sample and rapidly scanned for most productive fields. After analysis and identification, data obtained were subjected to the same process on a ten-field basis as was the macrophyte information on a ten-quadrat basis.

Benthic and epiphytic: during macrophyte collecting (see above), samples of rocks and plants (major constitutents of macrophyte flora) were taken for recording of smaller flora. Lesser constituents of the macroflora were also collected where epiphyte presence was clear. Surfaces were analyzed by (i) scraping and separation of algae onto microscopic preparations, or (ii) removal of portions of 'host' surfaces and their direct examination under the microscope for epiphytes (e.g., *Chamaesiphon* on *Potamogeton crispus;* chantransia of *Batrachospermum* on *Cladophora glomerata* and *Ranunculus* spp.). The same ten-field process was used here as for plankton. Where epiphyte or benthos coverage was homogeneous and uniform, substrate examined was restricted to two areas of 3 mm^2; larger areas were examined where heterogeneity was suspected.

Results

(a) General

Estimates of surface cover, frequency and distribution are represented here as, (a) plans of distribution along stretches at/about stations (Figures 3A, 4A, 5B, 6A, 7A, 8A); (b) histograms showing percentage cover patterns on belt transects across the river width (Figures 3B, 4B, 5C, 6B, 6C, 7B, 8B); (c) tables detailing individual species occurrence in different life-states (Table 3) and on different substrata (Table 5) across the river, on a semi-quantitative basis (Whitton, 1975:96); (d) histograms showing species diversity (Figure 2) and components of community structure (Figure 9).

(b) Semi-quantitative measures

All the results are semi-quantitative only; direct counting or biomass estimation for the different life-states were not practicable, although allotment of levels to organisms was tempered with direct observational data where necessary for validity. The levels *common* (C) and *occasional* (O) are often employed in abundance estimates; here, these would have represented unnecessary complexity.

Macrophytes: semi-quantitative measures were derived as follows: species in each detailed quadrat were fully listed, and each species assessed as to number of quadrats in which it appeared. Levels used for abundance ratings are:—

presence in 1 quadrat only : rare (R)
2-3 quadrats : frequent (F)
4-5 quadrats : abundant (A)
6-7 quadrats : very abundant (VA)
8-10 quadrats : dominant (D).

The term subdominant has not been used, save in the subsequent discussion for abundant or very abundant forms/species having (by life-form, growth pattern, or sheer size) a major effect on all area flora components at the same or lower levels of abundance.

Microphytes: both planktonic and benthic/epiphytic semi-quantitative assessments employed a similar process on the ten-field basis to that used on a ten-quadrat basis for macrophytes. Levels for the abundance ratings are:—

presence in 1 field only : rare (R)
2-3 fields : frequent (F)
4-5 fields : abundant (A)
6-7 fields : very abundant (VA)
8-10 fields : dominant (D).

(c) *Comments*

Generalised distribution of plants recorded, indicating only outstanding characteristics of dominance/frequency or rarity (but noting presence/absence for all), is presented in Table 3. A few changes between summer and winter distributions require further comment (see later), since they reveal 'natural' phasing or seasonality to be considered before conclusions are reached on value of taxa as indicators. Outstanding seasonal indicators *are* utilisable, but their value is necessarily limited to those seasons and their use demands long-period data on the 'natural' phasing.

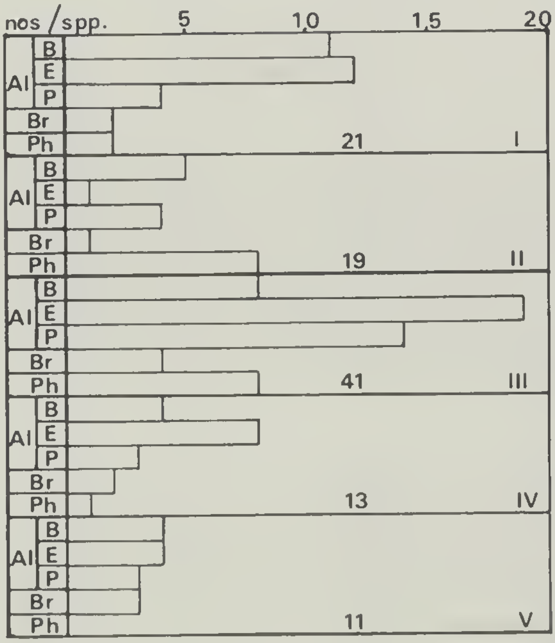

FIG. 2. Variations in species diversity with station along the Wandle. Inset figure (Roman) at lower right of each station entry is the station number. Central (Arabic) figures represent total species for the individual station. For other symbols, see key, p.28.

Much of the remaining representation of results is self-explanatory. Figure 2, based on the summer flora, indicates clearly the much greater species diversity at Station III than elsewhere. It also demonstrates the general progress of eutrophication through Stations I to III. Station I indicates greater variety of algae than of phanerogams, possibly as a result of intermittent pollution at or near the station (see Discussion). At Station II, the reverse seems to apply to comparative species diversities. Any reflection of this in biomass terms is not covered in Figure 2. The reducing or eliminatory effects of events between Stations III and IV, and the progression of effects on from IV to V, appear clearly; this is so for numbers of both algae and phanerogams. Species cover across the belt transects at stations is detailed as histograms in Figures 3B, 4B, 5C, 6B, 6C, 7B and 8B; Figures 6B and 6C represent winter observations only. The patchiness of distribution is established to a degree in all cases; localization of some elements (e.g., *Rorippa; Apium*) to sides of the river is demonstrated in Figures 4A and 4B for Station II, whilst other elements (e.g., *Callitriche,* Figures 3B and 4B; *Elodea,* Figures 4B and 5B; *Ranunculus,* Figure 5B; *Zannichellia,* Figures 4B and 5B) are either usually present in flow areas of the centre of the channel, or generally distributed as a mosaic. With the exception of *Fontinalis* (Figures 5B and 5C, Station III), bryophytes tend to be lateral to the flow, usually on the banks (Figures 3A, 3B, 5B, 5C, 6A, 6C, 7A, 7B, 8A, 8B), but are largely absent where banks are unconsolidated (Figures 4A and 4B, Station II).

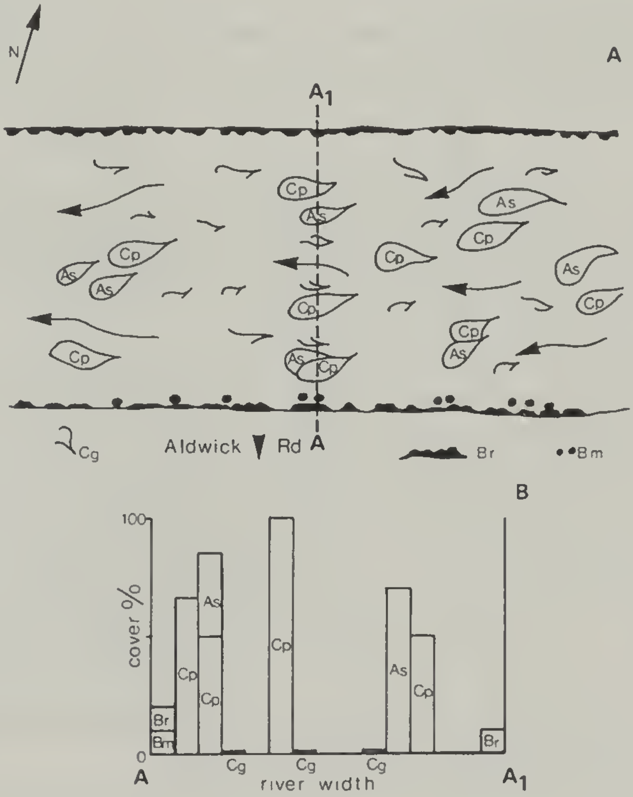

FIG. 3. Station I (Aldwick Road).

A. Transect area, line marked A_1-A. Macroflora distribution as surface plan of the stretch. Scale approximate only.

B. Percentage cover of major flora across the river along transect line. Basis details in text. For symbols, see key, p.28.

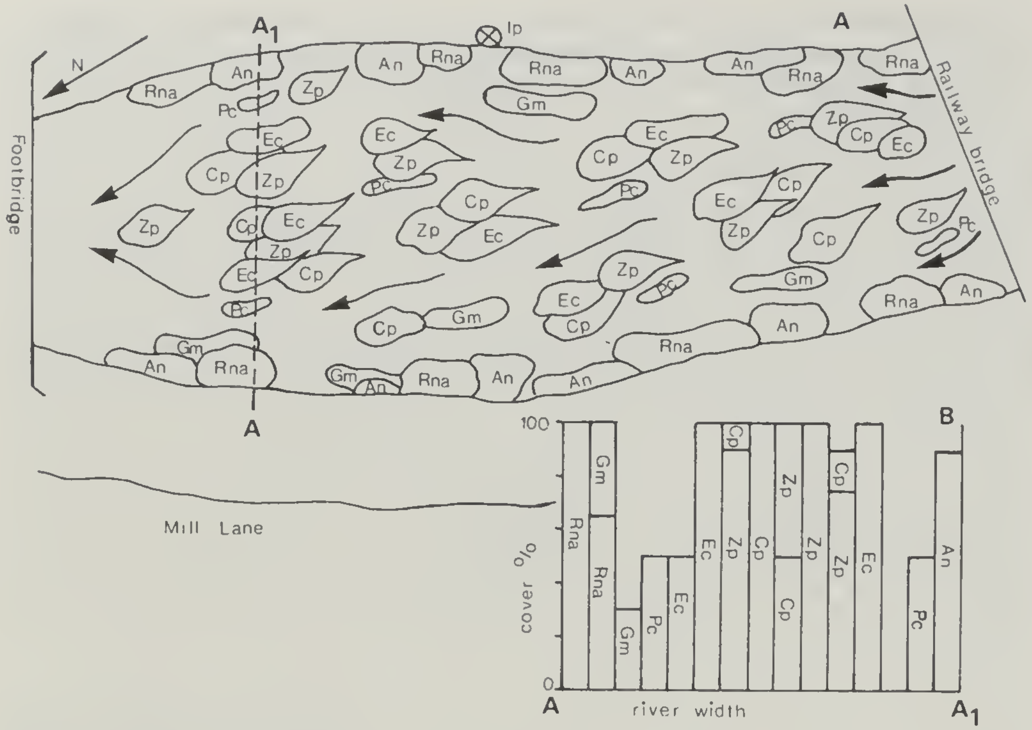

FIG. 4. Station II (Mill Lane).
A. Transect area, line marked A_1-A. Macroflora distribution as surface plan of stretch. Scale approximate only.
B. Percentage cover of major flora across the river along transect line. Basis details in text.
For symbols, see key, p.28.

Phanerogamic seasonality is demonstrated at Station III by comparison of the summer distribution (Figures 5B and 5C) with the winter state (Figures 6A and 6B), when the phanerogamic cover has effectively been maintained across the belt transect but seems virtually taken over by *Ranunculus fluitans** in luxuriant growth. *Glyceria* (lateral) and *Elodea canadensis* (scattered centrally) remained present in winter but are not separately shown.

Some *Cladophora glomerata*, associated with peripheries of clumps and bases of plants of *Callitriche* and *Agrostis*, was present at Station I (Figures 3A and 3B); very patchy *Batrachospermum* also occurred on stones. The importance of *Cladophora* in the cover increased greatly by Station IIIA, beyond the treated sewage effluent inflow (Figures 6A and 6C), after abundant but locally poor representation at Station III (Figures 5B and 5C) caused its absence from the immediate transect line area there. Comparison between the figures (5B/5C and 6A/6C) clearly demonstrates an equally dramatic reduction in phanerogam species by IIIA and coverage reduction in even those species that do persist. At Station IV (Figures 7A and 7B), absence of all phanerogams but *Ranunculus* and presence of only very intermittent lateral patches of even *Cladophora* are clear; by Station V (Figures 8A and 8B), even *Ranunculus* no longer persists. Remaining lateral patches of *Cladophora* showed some increase in bulk, possibly attributable to the tannery inflow between stations.

Components of community structure (Figure 9) further emphasise the general reduction in coverage and 'community' complexity between Stations III and IV, continuing through to Station V. Similarly demonstrated is dominance by single species well-adapted to the particular conditions at each station, with consider-

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*Reservations as to this naming derive from difficulties in distinguishing between longer-leaved forms of *R. penicillatus* var. *penicillatus* and *R. fluitans*.

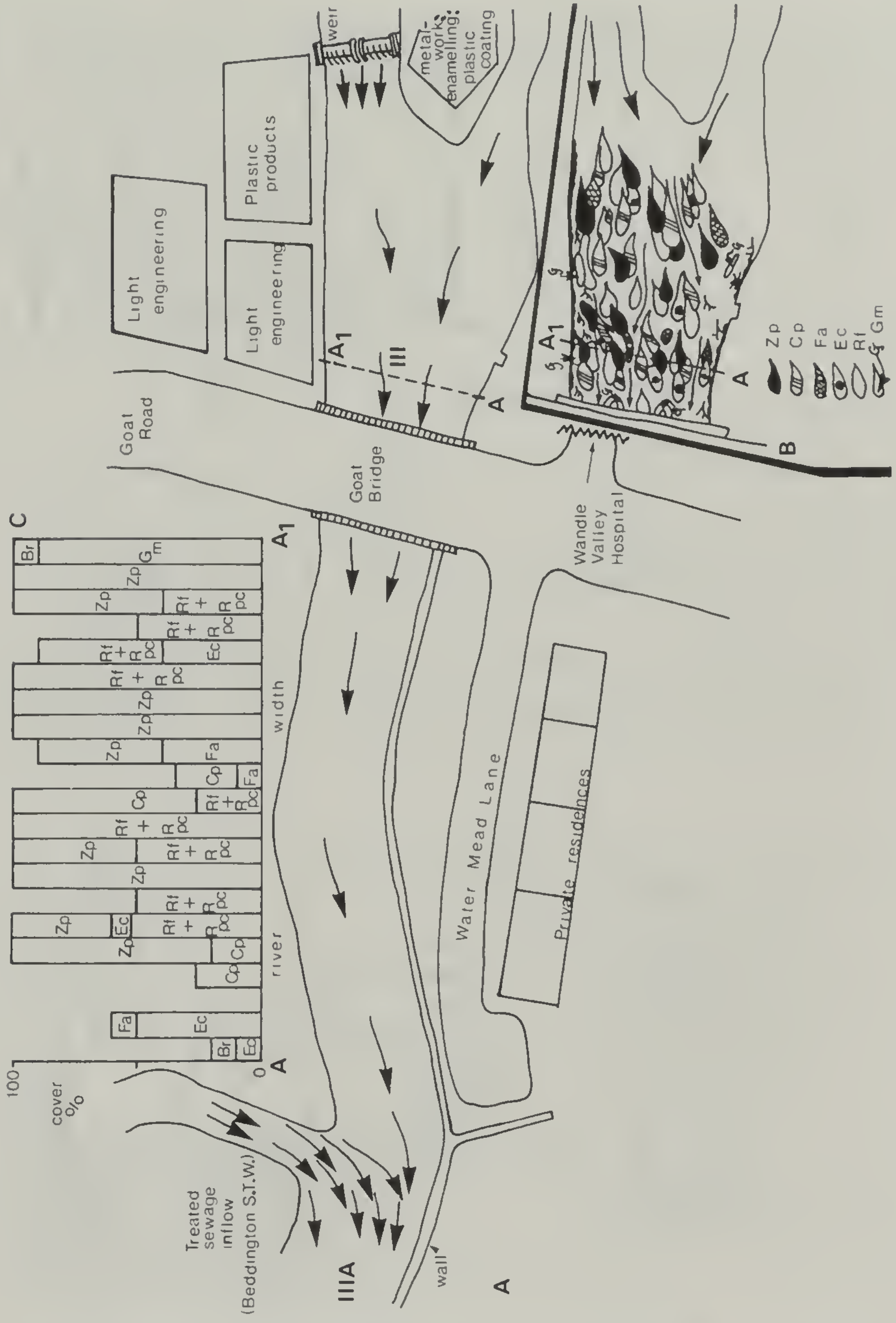

FIG. 5. Stations III and IIIA (Goat Bridge and Beddington Sewage Treatment Works effluent).

A. Transect area and positional relationships of Stations III and IIIA. Only approximately scaled.

B. Macroflora distribution as surface plan in Station III area. Only approximately scaled. Density of flora and crowded distribution very complex, hence the need for additional pictorial symbols. For symbols, see key, p.28.

C. Percentage cover of major flora across the river along Station III transect line. Basis details in text.
For symbols, see key, p.28.

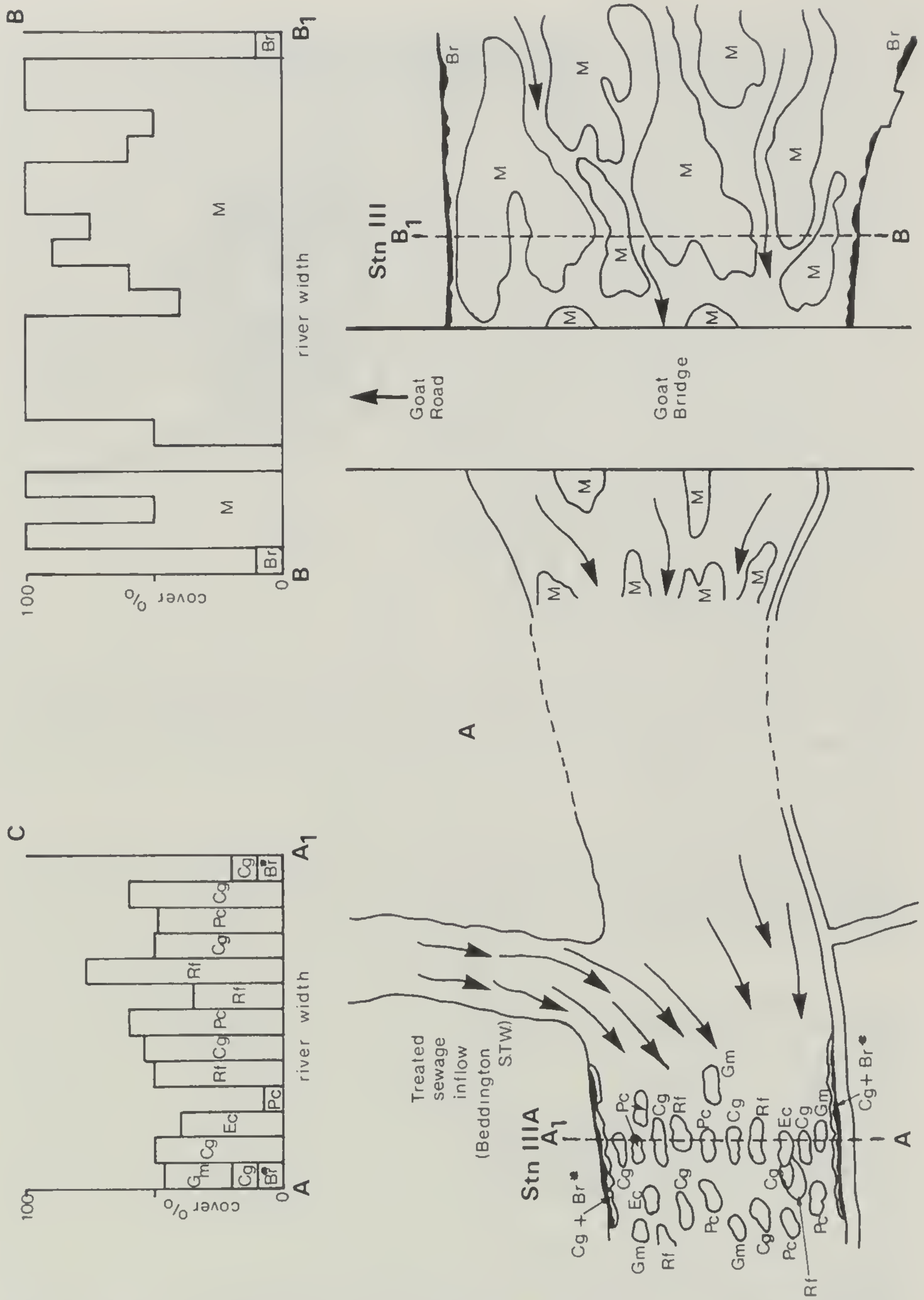

FIG. 6. Stations III and IIIA (Goat Bridge and Beddington Sewage Treatment Works effluent). Winter observations, January 1980.

A Macroflora distributions as surface plans at Stations IIIA (A_1-A) and III (B_1-B). Only approximately scaled.

B. Percentage cover of major flora across river at transect area B_1-B, shown as all macrophytes, *Ranunculus fluitans* dominant. For further details, see text. Only approximately scaled.

C. Percentage cover of major flora across river at transect area A_1-A. Only approximately scaled.

For symbols, see key, p.28.

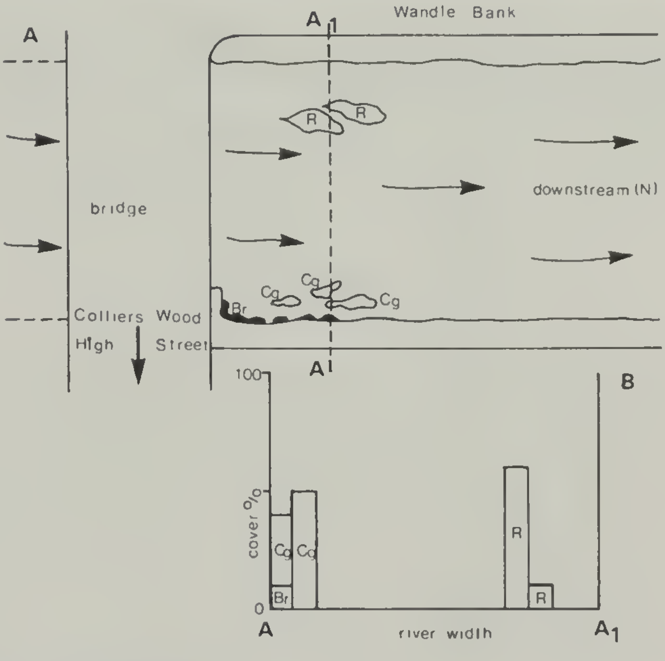

FIG. 7. Station IV (Wandle Park).
A. Transect area, line marked A_1-A. Macroflora distribution as surface plan of stretch. Only approximately scaled.
B. Percentage cover of major flora across the river along transect line. Basis details in text.
For symbols, see key, p.28.

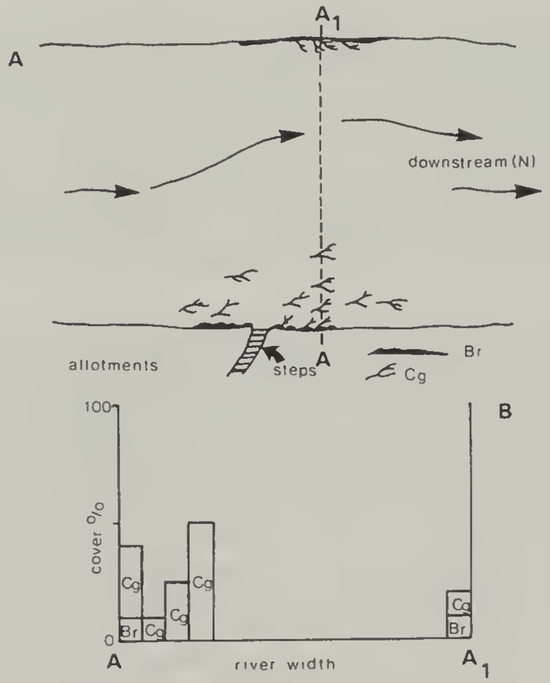

FIG. 8. Station V (Summertown, Garratt Park).
A. Transect area, line marked A_1-A. Macroflora distribution as surface plan of stretch. Only approximately scaled.
B. Percentage cover of major flora across the river along transect line. Basis details in text.
For symbols, see key, p.28.

able change at levels of presence below that from rather few species exhibiting good individual growth and spread (Station I) to many more species multiplying in both cover and vigour (Station III).

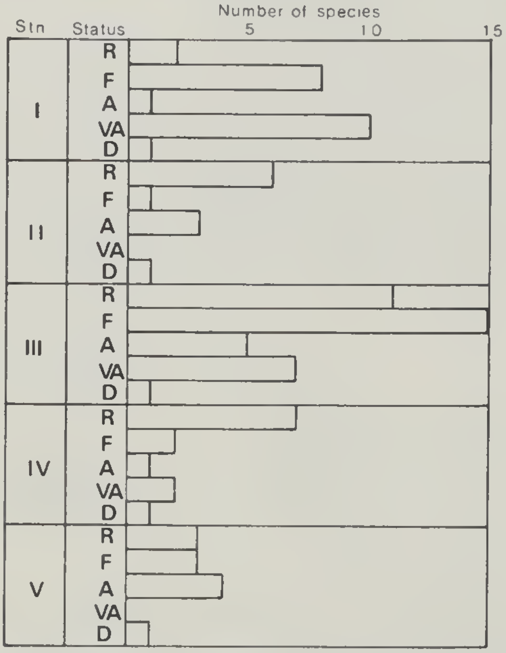

FIG. 9. Stations I-V. Histograms demonstrating frequency of species against diversity, for each station separately, and hence components of community structure. Roman figures are station numbers; status letters explained in text.

Table 5 summarizes detailed levels of occurrence of individual algal species from different life-states and for different substrata across the river at transect points, again semi-quantitatively. Although the table is largely self-explanatory, it is worth emphasising the clearly shown importance, or lack of it, of substrate type for the various benthic species. Potential 'host' plants were surprisingly clear of epiphytes at Station II; this is being studied further. The phanerogamic pattern of increasing diversity, luxuriance, 'community' complexity, and cover, from Stations I to III is otherwise generally re-emphasised by the algae, as are the dramatic reductions in almost all these characteristics from Stations III to IV, continuing through to Station V.

A few winter observations are not illustrated here. Station I showed *Batrachospermum* generally distributed throughout the river bed in winter, although restricted to shaded areas by the river bank in summer (Figures 3A and 3B). This alga disintegrates in summer high-light conditions (Whitton, 1975: 92). Station II was generally poorer in cover for all plant species in winter than in summer. Figures 6A and 6B illustrate the winter situation for Station III. Station IIIA, examined only in winter, is discussed as to importance later, and cover patterns are presented in Figures 6A and 6C. *Cladophora* was considered above. The detected *Potamogeton crispus* was all young; *Elodea* and *Batrachospermum* occurred only in the lee of clumps of river-bed debris that sheltered them from the strong current. *Ulothrix* and *Vaucheria* appeared on the west side, along the stabilized river-bank. A thin film of 'sewage fungus' covered most of the flora and was present (*Carchesium* dominant, with organic debris and mostly dead pennate diatoms) in the plankton samples. At Station IIIB, drift *Potamogeton* occurred; *Cladophora* was dominant on lateral parts, with some *Amblystegium riparium*. By Station IIIC, a few patches of scattered *Ranunculus* were present, *Cladophora* again being laterally dominant. Other algae included *Phormidium*, *Vaucheria, Spirulina* and *Stigeoclonium*, with *Meridion* and *Synedra* epiphytic on *Cladophora*. Station IV transect area carried one patch of *Ranunculus fluitans*, a species not seen there in summer (when the water was generally more turbid and *Ranunculus* spp. usually poor if present at all); *Cladophora* formed a lateral band with bryophytes. Station V showed no significant difference between summer and winter flora; water turbidity was always high, but not quite so high as the worst of Station IV.

Discussion and Conclusions

1. *The River*

The 1970s have seen great improvements in the general water-condition; Aston *et al.* (1979) commented that the main reduction of Metropolitan Watercourse pollution in 1970-1977 was in the Wandle. McCrow (1974), from work done in 1970-71, indicated a large proportion of the G.L.C. regular (monthly/quarterly) samples to be unsatisfactory as regards Royal Commission on Sewage Disposal recommendations. Improvements were then being carried out; the primary sources of effluent input at that time were the sewage works at Wimbledon, Wandle Valley and Beddington. The processes, progress and detailed nature of the amelioration have been examined by Aston *et al.* (1979); there was considerable reduction in sewage discharge, the whole Wimbledon Works flow and part of the Wandle Valley flow being diverted (1971) to Crossness Works, on the Thames. Beddington commissioned a new activated sludge works (1970) and its effluent quality thereafter steadily improved, whilst the rest of the Wandle Valley flow was also diverted to Crossness during the early 1970s. Aston *et al.* commented in 1979 that 'The biological life has been stable since 1973 and now supports large populations of a limited number of species including the water louse, *Asellus aquaticus*, certain molluscs, leeches, midge larvae and oligochaete worms, which result in a steady biotic index of 4 below the effluent discharge.' By 1978, 100% of all Wandle samples met the N.W.C. quality classifications applied of 1B (Goat Bridge) and 3/2 (Watermeads and Causeway) (Dart, 1979). Aston *et al.* (1979) suggested that a very clean river in an urban area should have chemical indices of 1B (NWC), (9) (Clyde system), and a biotic index (invertebrates) of 7. Other standards for stretches or whole rivers were considered to need indices of 2(7) (chemical), 5-6 (biotic), for category 2 and a description 'satisfactory' (very few polluting discharges); 2(5), 4, for category 3 (more persistent discharges or a high proportion of well-nitrified sewage effluent); 3(3), 3, for category 4 (high proportion of treated sewage effluent); 4(0-2), 0-2, for category 5 (gross pollution).

Goat Bridge maintains a 1B classification. parts of the upper reaches lie in category 2 (satisfactory), and the lower reaches, carrying amongst other things treated sewage effluent, are in category 4. Some discrepancies are known between the indices; Thames Water Point 1 (Aldwick Road) showed a biotic index of only 3, despite a chemical index of 1B(10). Intermittent unidentified discharges in culvert under Croydon were thought to explain this. Biological lag in following chemical amelioration is not wholly surprising.

Apart from amelioration in biotic index, there are signs that the river's earlier reputation (Camden, 1586, and Isaac Walton) as '. . . so full of the best trouts' may eventually be restored. Torr (1918, 1970) amplified this earlier reputation in stating that from 1866 to 1878, when his father fished the Wandle near Mitcham, trout of up to 1lb weight were thrown back in to give them a chance of growing bigger whilst just a few of the larger (2-3lb) fish then present made a good catch. Although McCrow in 1970-71 could only find sticklebacks in the upper reaches, a trout (weight 1lb) was caught on a line at Southfields in early 1979 (*The Observer*, 21 January 1979); this was the first such since 1913 (*cf.* Twilley and Wilks 1974). Aston *et al.* (1979) stated that the lower reaches, where physical features are also

TABLE 5. Semi-quantitative assessed levels of occurrence of algae in different life-states and for different substrata at stations (transects and transect areas) along the Wandle. Basis explained in the text.

LIFE - STATE/ SUBSTRATE	P	B	B	E																
ALGAE	Planktonic	Rocks	Mud	*Cladophora glomerata*	*Amblystegum riparium*	*Bryum argenteum*	*Ceratodon purpureus*	*Fontinalis antipyretica*	*Marchantia polymorpha*	*Physcomitrium pyriforme*	*Agrostis stolonifera*	*Apium nodiflorum*	*Callitriche platycarpa*	*Elodea canadensis*	*Glyceria maxima*	*Iris pseudacorus*	*Potamogeton crispus*	*Ranunculus* spp.	*Rorippa nasturtium-aquaticum*	*Zannichellia palustris*
Chamaesiphon incrustans																	II(F)(F)			
Coelosphaerium kuetz																				III(F)(VA)
Nostoc parmelioides																		III(F)(A)		
Oscillatoria spp.	I(drf)	I(F) II(R) IV(VA)	I(F)		IV(VA)(F) V(F)(F)				I(F)(F) IV(VA)(R) V(F)(F)	V(A)(F)								III(F)(A) IV(F)(R)		
Phormidium sp.					IV(VA)(F) V(A)(F)				IV(VA)(R) V(A)(F)	V(F)(F)								IV(F)(R)		
Rivularia sp.		I(VA) II(A) III(R)																		
Spirulina sp																		III(R)(A)		
Batrachospermum monil	I(drf)	I(VA)																		
Batrachosp. mon 'chantransia'		I(A) II(R)		III(F)(VA)														III(F)(A)		
Pseudochantransia sp		I(VA) II(A) III(R)																		
Euglena sp			I(R)																	
Tribonema sp														III(R)(A)				IV(R)(R)		
Vaucheria sp	III(drf)	I(F) III(F) V(A)	I(VA)		I(A)(VA) III(A)(A) V(F)(F)	III(F)(R)	III(F)(R)		I(A)(F) V(F)(F)	V(R)(F)	I(A)(VA)		I(A)(VA)	III(F)(A)			III(F)(F)	III(F)(A)		
Bacillaria paradoxa	II(R) III(VA) IV(R)																			
Diatoma sp		III(F)	I(F)		I(F)(VA)															

Fragilaria sp.	III(F)				I(F)(VA) III(F)(A)	III(A)(R)	III(F)(R)	III(F)(A)												III(F)(VA)
Melosira spp	I(VA) III(VA) IV(R)	I(F) III(A)	I(F)		I(A)(VA) III(A)(A)	III(F)(R)	III(F)(R)						III(A)(VA)	III(A)(A)			III(F)(F)	III(VA)(A) IV(F)(R)		III(VA)(VA)
Meridion circulare																				III(F)(VA)
Synedra sp	I(R) II(R) III(F)				I(F)(VA)															
Tabellaria fenestrata	II(R)	III(F)			III(F)(A)		III(F)(R)	III(F)(A)			I(F)(VA)			III(F)(A)			III(R)(F)			III(F)(VA)
Cladophora glomerata	III(drf) V(drf)	I(A) II(A) III(VA) IV(A) V(D)	I(F)		I(VA)(VA) II(F)(F) III(A)(A) IV(R)(F)	III(A)(R)	III(F)(R)	III(VA)(A)	IV(F)(R)		I(VA)(VA)		I(A)(VA) III(F)(VA)	III(F)(A)			III(F)(F)	III(F)(A) IV(F)(R)		III(VA)(VA)
Closterium spp.	III(D) V(R)																			III(F)(VA)
Coelastrum sp.	III(R)																			
Cosmarium spp.	III(F)				IV(R)(F)															
Dictyosphaerium pulchellum	III(R)																III(F)(F)			
Eudorina elegans	III(F)																			
Gonium pectorale	III(F)																			
Microspora sp.											I(R)(VA)		I(R)(VA)							
Netrium sp.	III(R)																			
Oedogonium sp.	III(drf)	III(R) IV(R)											III(R)(VA)	III(R)(A)				III(R)(A)		
Pithophora oedogonia											I(VA)(VA)									
Spirogyra spp.	I(D) II(D) III(A) V(frag)	I(F)	I(F)		I(A)(VA) III(A)(A)	III(F)(R)	III(A)(R)	III(A)(A)	I(A)(F)				I(A)(VA) III(F)(VA)					III(F)(A)		III(VA)(VA)
Stigeoclonium sp.	IV(drf)	I(R) IV(D) V(A)			I(F)(VA) IV(A)(F)				IV(VA)(R)				I(F)(VA) III(R)(VA)					IV(VA)(R)		
Ulothrix sp.	I(drf) III(drf) V(drf)	I(F) V(R)	I(R)		I(F)(VA)			III(F)(A)			I(F)(VA)		I(F)(VA)	III(R)(A)				III(R)(A) IV(R)(R)		
Zygnema sp.								III(F)(A)												

Notes: 1. Relationships of entries to those of Table 3 are shown in heads: P (planktonic); B (benthic); E (epiphytic).
2. Entries in body of table present stations numbers at which the taxa occur on that substrate; first letter in brackets is frequency of the alga, the second,

suitable, are now capable of supporting a coarse fish community; re-stocking (*cf.* the Thames; Bulleid *et al.* 1982) has been projected.

2. *The Plants*

(a) General

With the reservations already outlined on results comparability and available time, the clear amelioration in chemical quality and biotic index (invertebrates) reported earlier does not appear to be unequivocally reflected in the benthic or planktonic plants. Few previous detailed data on benthic macroalgae or phanerogams have been traced for the Wandle (Table 4), so that its earlier state is only surmisable. What follows, therefore, constitutes summation of an initial examination of the utility of aquatic phanerogams, a few Bryophyta, and the algae in industrial and sewage pollution assessment *along* the Wandle in its current state. The possibility of future use of these data in a similar context to that of the 8 or 9 years' data on invertebrates (McCrow 1974; Aston and Andrews 1978; Aston *et al.* 1979) must await subsequent continuation, expansion, or repetition of present work over the years. Confines of this study are such that very local microhabitat data may have been overlooked or generalized out; it is unlikely that any significant short-term trends have been missed unless their occurrence is confined to spring or early summer.

(b) Macrophytes, particularly phanerogams

Available literature leads to the conclusion that macroalgae, aquatic macrophytes and bryophytes are not consistently reliable as indicators of other than gross environmental conditions and change. Westlake (1975) indicated that taxonomic mixtures represented by aquatic macrophytes (angiosperms, gymnosperms, pteridophytes, bryophytes, large algae) in rivers neither fit conventional phytosociological frameworks nor correspond well as communities with components of associations listed in, e.g., Segal (1968). The unstable complex mosaic of species varies continually from reach to reach, from time to time, and without necessary correspondence between similar environmental balances in different rivers (Holmes and Whitton 1981). Absence and dominance can be altered or completely reversed for individual species by small local variations, seasonal anomalies, or biological aspects such as dispersal failures. It is broadly feasible to associate some species with particular kinds of rivers, and to observe downstream trends, but natural absence of species may not be significant (Haslam and Wolseley 1981). Even recognition of life- or growth-form groups (e.g., in *Ranunculus*) with common environmental demand and therefore predictable distribution (sometimes a useful correlation) is difficult in many cases because of the usual aquatic problem of 'plastic' morphology.

Given this potential complexity of background, it would be extremely difficult certainly to identify any variation in effect on different macrophyte species under unusual environmental extremes, such as pollution. Any useful aquatic macrophyte (phanerogam or cryptogam) pollution-indicator system is therefore going to demand extremes of reduction in individual plant growth, in density of cover, or in similar phenomena, that cannot be set aside as operating for any other reason. Preferable (perhaps the only really acceptable indicator criterion) would be a pattern of total elimination firmly connected with the investigated conditions of environmental pollution. None could be unequivocally established within the time-scale of the present study, which is therefore indicatory rather than definitive. Not all workers adopt such an extreme stand-point; Haslam (1978) and Haslam and Wolseley (1981) argued that lesser variations can in some cases be very revealing of environmental stress (particularly of pollution) in rivers, on a community basis and *given adequate background data.*

Aquatic phanerogams here recorded suggest further research. Westlake (1975) summarized literature references indicating that many polluted rivers continue to support only macrophytes. Both he and Hynes (1970) refer to dramatic effects that may be found in extreme cases of smothering, anaerobic, or toxic pollutants (such as china clay, milk wastes, zinc, lead), whilst detergents at the concentration levels usual to effluents have been reported also to be toxic to plants. The almost total absence of aquatic phanerogams from Stations IV and V (Tables 3 and 5) requires further study in the light of this. An originally-suspected seasonal phenomenon was much less likely to be involved following establishment, from visits in January, 1980, that rather similar macrophyte winter distributions were present. McCrow (1974) reported 1970-71 data for The Goat (between Stations IIIA and IIIB); these similarly indicate no outstanding variations in flora with season. This is not to suggest that seasonal variations do not naturally occur in aquatic phanerogam assemblages; variations in genera, species, or numbers/distribution patterns are usual (as upstream of the Beddington effluent and around Goat Bridge, Station III) in less-affected areas. Goat Bridge showed the presence of dense stands of almost homogeneous *Ranunculus fluitans* (see earlier footnote) within the river channel itself in January, 1980; compare that with Figure 10, with Table 3, and with the detailed summer situation (Figures 5B and 5C) — a range of different species with varying patterns of cover.

Could the need for a longer-term clean-water period for recovery of aquatic phanerogams in significant diversity and amount, demonstrated elsewhere (see, e.g., Harding *et al.* 1981, on the River Etherow), apply here? Chemical and invertebrate biotic indices (despite the lag phase in response of the latter) for 1970-77 (Aston *et al.* 1979) showed amelioration to 1973, such that even continued improvement in water quality did not further affect the then stable invertebrate biota. This strongly suggests that some active aspect of environment at or near Stations IV and V remained insupportably adverse for general growth of aquatic phanerogams, although it does not necessarily reject an additional residual toxicity effect (see later).

Relevant factors in that environment are not easily identifiable. Possibly involved are Beddington Sewage Works effluent; paper-mill effluent upstream of Station IV (Colliers Wood); leather factory effluent upstream of Station V (Garratt Park). There certainly appears visually to be dramatic reduction in density and luxuriance of aquatic phanerogams beyond the inflow point of the Beddington effluent (Station IIIA). That point demonstrates increase in organic residues within the now effluent-affected river, as well as increase in flow-speed, depth of flow, and water turbidity; compared to the immediately upstream area of Goat Bridge (Station III), also, the flow-channel narrows somewhat. Increases in flow-speed and depth are not maintained for very long: by Station IIIB (Watermeads), the situation is much as it was in those aspects before the effluent inflow. Nevertheless, the only phanerogams detected at IIIB were drift plants of *Potamogeton,* and then only in summer. A small amount only of *Ranunculus fluitans* was noted, winter and summer, at Station IV.

The flow-speed of the effluent in the early stages of its merging with the river may be a factor because, initially, reduction in the phanerogam flora is more apparent than real. Depth, strength of flow and increasing turbidity combine to conceal the reality of abundance in *a few* macrophyte species. Flow-speed prevents the development of significant amounts of 'sewage-fungus', denies the full depressing effect of increased turbidity, and may disturb any local basal silt. With flow-speed decrease over increasing downstream distance from the inflow, sewage-fungus becomes a more effective smothering agent and turbidity increases in effect. McCrow (1974) recorded for 1970-71 from point 3 (Goat) between III and IIIA, a few metres upstream of inflow from the lower trading estate, water frequently so turbid that the bed could not be seen and suspended solids were consistently present, with '. . . no aquatic plants . . . visible'. Note that the phraseology does not exclude presence, merely establishing invisibility. Conditions must be taken to have ameliorated there and turbidity to be less consistently high, but that situation was directly comparable to the conditions at Station IIIA, just beyond the treated sewage inflow. Phanerogams, then, gradually grade out, possibly accelerated by sewage-fungus growth and increased turbidity, augmented by high organic content of the paper-mill effluent just before Colliers Wood (Station IV). Effects, especially turbidity, are probably again topped up by the leather factory outfall before Station V. *Cladophora* and other algae from Station V were all coated with a fine surface scattering of small brown globules, doubtless tannin residues.

Aquatic phanerogams may thus be indicating pollution effects along the Wandle, on a presence/absence basis. What precisely is it that they are indicating? Westlake (1975) postulated that the most widespread effect of pollution on aquatic macrophytes is probably through increased turbidity and deposition of silt on the leaves, both reducing available light and thus depressing photosynthesis and growth. He suggested that, provided turbidity is not increased, macrophyte growth is likely to be maintained under organic pollution and the consequent increase in nutrients. The Wandle situation occurs in the context of an essentially clear-water, chalk-derived stream that flows over an often stony bed. Left to its own devices, the river lacks a widespread source of abundant siltation and, even in its lower alluvial-affected reaches, would not attain significant proportions of current turbidity levels. The Wandle would thus appear to support Westlake's postulate of pollution eradicating through turbidity, but see the later comment on detritus retaining toxicity.

The results outlined would suggest that Goat Bridge area (Station III), upstream of the effluent entry, represents the present optimal eutrophication balance for growth of aquatic phanerogams and macroalgae. We raised above the question of possible need for longer-term clear-water periods for recovery of aquatic phanerogams in stretches now lacking them; it would therefore be interesting to know if comments by Aston and Andrews (1978) on evidence of 1976/77 spreading of *Elodea nuttallii* involved characteristics of an amelioration pattern leading to recovery spread of phanerogams in general, or related to vigorous invasion by a 'newcomer'. Taxonomic uncertainty about the status of *E. nuttallii* and doubt as to the way the name is being applied both complicate this matter. The desirable continuation of this present initial survey could establish whether the dense growths of phanerogams at Station III in both summer (1979) and winter (1979/80), the latter with fewer taxa, form any indication of recovery and active spread.

Indicator status of aquatic phanerogams seems equivocal in one case. Station I (Aldwick Road, Croydon Arm) represents the same location as that monitored by Thames Water; sampling by the latter authority gave a high quality chemical index in recent times (1B(10)), although this is not reflected in the biotic index. It is similarly unsupported by the aquatic phanerogam growths; the two species present (*Callitriche* and *Agrostis stolonifera*) do well only where they are established in clumps. Turbidity of the water is in our experience low; if high turbidity is really the major restrictive agent in effects of organic pollution on aquatic phanerogams, the situation there seems anomalous.* Water depth, usually about half that at Mill Lane (downstream), does not seem likely to limit plants, save for very sensitive emergents or submergents requiring considerable depths. Whatever form the intermittent pollution in culvert under Croydon does take, it must appear to be affecting many of the early stages of phanerogams otherwise likely to be present in the Aldwick Road stretch below. An analogous station (The Grove) on the Carshalton Arm was found in even the polluted 1970-71 era (McCrow 1974) to carry 'flourishing growth of aquatic plants', including some species not currently present at Aldwick Road.

*BM colleagues (D. M. John, L. Johnson, and Ms J. A. Moore) noted murky waters with organic detritus (after very heavy prolonged precipitation during mid-November) on 23/11/82. Phanerogams were not detected.

(c) The Algae

General neglect of the macroalgae and the plankton in riverine pollution assessment has already been mentioned. Of late, the neglect has been less, although (Bolas and Lund 1974; Saunders and Eaton 1976; Holmes and Whitton 1981) critical determinatory and field-work required are certainly time-consuming, and the detailed taxonomic background is often lacking or imponderable. Even sampling procedures are commonly tedious, however important is the standardization. Space in publications can also restrict the detail in coverage, especially where more easily-recognisable and quantifiable phanerogams constitute adequate indicators. The text on *River Plants* (Haslam 1978) exemplifies that situation; the introduction emphasises primary concern with the angiosperms and the glossary entry for 'Algae' comments that '*Chara* and *Enteromorpha* are unusually large, and are the only algae named in this book'. How *Cladophora glomerata* can be ignored in many locations is not clear (*cf.* Bolas and Lund 1974; Harding *et al.* 1981; Holmes and Whitton 1981; Hynes 1970; Whitton 1970, 1979).

There remain also constraints outlined by Whitton (1975) and Wilhm (1975) — an appreciable lack of agreement between different field-methods and different mathematical indices, aside from that between different workers, as to the true 'indicator' status of many species. Regional differences in flora, viewpoints of investigators, type of pollution under review, and other factors, all affect this. Wilhm's view is extreme — it is '. . . unlikely that using specific organisms as indicators will ever be widely accepted'. Whitton was a little more optimistic in adding '. . . conspicuous growths of a few species do appear to provide some guide to environmental conditions'. Still, some few publications have outlined interesting relationships and potential cases of 'indicator species' amongst the algae, both benthic and (to a lesser extent) planktonic, in lotic and lentic British rivers. Particularly interesting examples are those by Butcher (1932, 1933, 1940, 1946, 1947 (especially), 1955) and by Swale (1964), as well as the various studies by Whitton and colleagues.

Seasonal variations in the Wandle macroalgae are here considered only peripherally. Such variations are usually recorded for both benthic and planktonic algae of rivers and lakes, although the variations themselves show year-to-year, place-to-place, and river-to-river variation (Butcher 1946 and others; Marker 1976*a*; Holmes and Whitton 1981; Swale 1964). The seasonal variations may concern genera, species, or numbers; if the latter changes are extreme, such that sampling on a standard basis is not likely to detect the small numbers to which some species are reduced, the appearance will be of generic or specific change.

It is instructive to compare the Wandle situation with some other rivers and calcareous streams for which there have been attempts to demonstrate benthic and planktonic variation under pollution inflow. Butcher (1947) considered the rivers Trent, Tame, Churnet and Bristol Avon. Swale (1964) and Marker (1976*a*), less comprehensively as to algal sequences with time and distance, commented on the Lea [a left-bank tributary of the Thames, rising in chalk and flowing over a stones/gravel/mud bed; a longer river, but similar to the Wandle since affected by treated sewage and warm water effluents], and the Dorset/ Hampshire hard- and soft-water streams (largely unaffected by pollution) respectively. Marker has challenged Butcher's earlier (1946) conclusion that in calcareous streams (Itchen, Test, Hampshire Avon) there was little pronounced seasonal variation; the difference of opinion is interesting and the balance seems to be with Marker. This does not significantly affect the application here of Butcher's (1947) scheme of general effects of pollution on the algal flora (Table 6).

TABLE 6. Summary of the general scheme (Butcher 1947) of the algal flora of rivers at different pollution states (principally based on R. Trent).

1. Polysaprobic (organic decay very great; thick felt of sewage fungus)

dominant:	*Stigeoclonium tenue**	resistant, not requiring conditions; also appear in: mesosaprobic/oligosaprobic/eutrophic
subdominant:	*Gomphonema parvulum*	
	Nitzschia palea	
	Protozoa (pigmented and unpigmented)	

2. Mesosaprobic

dominant:	*Nitzschia palea*
	Gomphonema parvulum
subdominant:	*Stigeoclonium farctum**
	*Stigeoclonium falklandicum**
very rare:	*Cocconeis placentula*
	Chamaesiphon spp.

3. Oligosaprobic climax community in any river (oligosaprobic and eutrophic states very close)

Cocconeis placentula
Ulvella frequens
*Chamaesiphon incrustans***
*Chamaesiphon regularis***

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*Possibly clinal variation between species; distinguished only on variation in extent of development of prostrate/erect systems.
**Distinguished only on overall size; not clear-cut.

On the basis of abundance assessments detailed earlier, a general summary of the algal situation along the Wandle is presented in Figure 10. Currently, the closest approach to a standard eutrophic 'climax' algal 'community' for the Wandle differs in important characteristics from that suggested by Butcher on a wider basis, although application of the latter's criteria is revealing for this river. The 'climax community' along the Wandle has to be regarded for the present as that at Station III (Goat Bridge); the natural progressive eutrophication process that occurs along unpolluted rivers has reached its current maximum by then, before the treated sewage effluent joins and strongly affects the river at Beddington Corner. It is not clear just how close an approach to this river's natural climax algal flora is the Station III summer situation. It may not be particularly close by comparison with the scheme presented by Butcher. *Chamaesiphon*, the only genus detected of those given by Butcher as usual to the eutrophic climax, was present at Station II but not (perhaps a chance sampling phenomenon) at Station III; at II, it was only 'frequent', in abundance far below the dominant *Spirogyra*. Even at III the latter was very abundant, although since the river moves consistently here and *Spirogyra* was only epiphytic (periphyton) or planktonic, the alga may have derived from populations in some nearby slower-moving lateral channel. *Stigeoclonium*, apparently absent from Station II, was epiphytic but rare at Station III, having been frequent (on *Agrostis*) at Station I. This points to eutrophication from a higher level of organic pollution (i.e., a trend towards the oligosaprobic from the mesosaprobic), and again the sequence could well reflect some effect of the unknown intermittent pollution at or before Aldwick Road (Station I). Longer-term data are required on this.

FIG. 10. General summary of algal dominance patterns along the River Wandle: planktonic and all substrata benthic combined. (Compare with extract of generalised scheme derived from Butcher 1947, presented in Table 6).

	STATION I	STN II	STN III	IIIA	STN*IIIB	STN IV	STN V
DOM.	*Sp*	*Sp*	*Clo*	*Cl*	*Cl*	*St*	*Cl*
SUBD.	R/B/Ps/ V/M/Cl Pi		Ba/M/Sp/Cl			O/Ph	
ABUND.	Bc	R/Ps/Cl	V/F			Cl	Ph/V/St/O
FREQ.	O/D/F/ S/T/St/ U	Ch	Co/N/O/Bc/ D/Me/S/T/ Ed/G/Di/U/ Z/Cos		St	M	
RARE	E/Mi	Ba/O/Bc/ S/T	R/Spa/Ps/ Tr/Coe/St/ Oe/Ne	B/Sp	Spa	Tr/Cos/Ba/ U/Oe	U(d)/Clo/ Sp(d)
	STATION I	STN II	STN III	IIIA	STN*IIIB	STN IV	STN V

STATION IIIA INFLOW OF TREATED SEWAGE EFFLUENT

SEWAGE FUNGUS DENSE

SEWAGE FUNGUS DENSE

SEWAGE FUNGUS DENSE

SEWAGE FUNGUS EASING

OUTFALL TO THAMES

Key

B	*Batrachospermum*
Ba	*Bacillaria*
Bc	*Batrachospermum* chantransia
Ch	*Chamaesiphon*
Cl	*Cladophora*
Clo	*Closterium*
Co	*Coelosphaerium*
Coe	*Coelastrum*
Cos	*Cosmarium*
D	*Diatoma*
Di	*Dictyosphaerium*
E	*Euglena*
Ed	*Eudorina*
F	*Fragilaria*
G	*Gonium*
M	*Melosira*
Me	*Meridion*
Mi	*Microspora*
N	*Nostoc*
Ne	*Netrium*
O	*Oscillatoria*
Oe	*Oedogonium*
Ph	*Phormidium*
Pi	*Pithophora*
Ps	*Pseudochantransia*
R	*Rivularia*
S	*Synedra*
Sp	*Spirogyra*
Spa	*Spirulina*
St	*Stigeoclonium*
T	*Tabellaria*
Tr	*Tribonema*
U	*Ulothrix*
V	*Vaucheria*
Z	*Zygnema*
(d)	drift

*IIIB here indicates the stretch of river (Willow Lane TO 277673 to Morden Hall Park TO 262687) that

The most interesting comparative phenomena occur at and after the sewage inflow at Beddington Corner. Butcher's data for the Trent indicated a lag phase of some 2 to 3 miles before the river attained sufficient purifying capacity, after organic enrichment by pollution inflow, for the characteristic polysaprobic dominants (*Stigeoclonium, Nitzschia, Gomphonema*) to 'take off' in an extremely rapid impressive multiplication of numbers. Algae were assessed by Butcher on the basis of numbers/sq. mm on glass slides in the river. In the Wandle, the first signs of *Stigeoclonium* undergoing imminent increase occurred along the Willow Lane-Morden Hall Park stretch, in samples from Morden Hall Park (The Lodge). This is about 1.75 (river) mls distant from the inflow at Beddington, and, considering the amelioration in effluent quality (probably much higher now than was the discharge to the Trent, 1938) tallies well with Butcher's earlier findings.

By eight miles from the Trent effluent inflow, Butcher noted *Stigeoclonium* at a maximum of 15,300 plants/sq. mm in polysaprobic conditions that carried a felt 30-100 mm thick of sewage fungus on all stones of the river bed. By Station IV (Colliers Wood) in the Wandle, after augmentation of pollution effect by the paper-mill effluent a little upstream, sewage fungus formed a dense cover over available surfaces and *Stigeoclonium* was dominating the algal flora, followed by a mixture of *Oscillatoria* and *Phormidium*. Station IV is some 1.26 (river) miles further on than Morden Hall Park Station (IIIC), a total of 3.01 mls from the effluent outfall; accepting sewage effluent and natural variations between rivers, this is again remarkably similar to the Trent. By Station V (Garratt Park), 1.5 (river) mls beyond Station IV, conditions had already eased; sewage fungus was still well in evidence but much less dense than at Station IV, and *Stigeoclonium* had dropped to joint subdominance of the algal flora with *Phormidium* and *Oscillatoria* and, lateral to the stream, *Vaucheria*. None of these genera was more than abundant, the clear dominant then being the macrophyte *Cladophora glomerata*. Absence of epiphytic *Stigeoclonium* (despite presence of a usual substrate, *Cladophora*) and its overall reduction from dominant to subdominant (abundant) levels, together suggest a change of river status at or near that point from polysaprobic to mesosaprobic conditions.

Throughout, the fairly tolerant *Cladophora glomerata* performs in a manner reasonably to be expected and may represent a potential indicator, although not quite in the same light as *Stigeoclonium*. Whitton (1970, 1975, 1979) indicated that the fresh arrival at a site of a large growth of *Cladophora* suggests the probability that some form of nutrient eutrophication has occurred; further detail supporting that appears in Bolas and Lund (1974), Harding *et al.* (1981) and Holmes and Whitton (1981). *Cladophora* was always at least abundant along the Wandle, implying that zinc pollution, at least (to which the alga is sensitive; Whitton, 1970, 1979, 1980; Harding *et al.* 1981), was not acting here. The growth form of *Cladophora glomerata* varies from long tough ropes (faster flows) to thick plumose growths (slower waters). In the Wandle (Table 5), *Cladophora* (long rope-like form) is the immediate algal dominant on entry of the Beddington Corner effluent; it drops from dominance (by Station IV) under the combined effects of tremendous growth of *Stigeoclonium* and 'sewage fungus', although it remains abundant in the now-slowing flow. By Station V (with mesosaprobic trend and 'sewage fungus' easing), *Cladophora* regained dominance, principally due to slackening of *Stigeoclonium*. The *Cladophora* growth-form in slower areas of the Wandle is certainly shorter and more clumped, as are many plants at Station V.

Stigeoclonium dropping from dominance and *Chamaesiphon* not reappearing as an indicator of Butcher's oligosaprobic conditions are interesting. The implication (which requires checking by detailed periodic collections and establishment of more stations nearer the outfall to the Thames) is that the Wandle has insufficient length fully to regain eutrophic conditions in the presence of: (i) the current quality of sewage effluent; (ii) the sewage effluent outfall position relative to the total length of the river; (iii) the usual volume of water flowing; (iv) additional outfalls from paper and leather works downstream of the treated sewage inflow; (v) the probable back-up effects of Thames tidal movements. The total distance from Beddington outfall to the Wandle outfall to the Thames is about 7.2 (river) miles; the Trent, much larger than the Wandle, regained eutrophic or oligosaprobic status (on Butcher's criteria) at about 35 miles from the effluent entry. The Wandle situation is somewhat similar to that noted by Butcher for the Tame, then a polluted tributary of the Trent. The Tame was only just passing from polysaprobic to mesosaprobic condition some 40 miles from effluent inflow, being a much more polluted stream than the Wandle. Shortly after that, the Tame flows into the Trent at a point where the latter was then oligosaprobic and the two rivers had approximately equal volume. The resultant stream was again mesosaprobic, although it quickly regained oligosaprobic condition.

There is another possible implication of the fact that the lower Wandle plant 'index' does not fully support the indications of chemical and invertebrate indices. Haslam and Wolseley (1981:vi) suggested that plants in a river recovering from pollution can be valuable indicators of true toxicity levels since they are more intimately associated with the substrate over which the water flows. A toxic detrital substrate retains that toxicity for longer than does the actual water, and substrate disturbance by flow or other conditions will potentially reintroduce toxins to the water. Thus, chemical and invertebrate indices may (correctly) reflect clean water conditions before plant indices do so, since benthic plants remain in contact with the toxic substrate. This *may* be at least part of the present lower Wandle situation (although this is not an especially silty river) and ' . . . it is only when each and all methods find a river clean that it can be assumed to be truly clean'. (Haslam and Wolseley 1981). If toxicity is being retained in whatever basal detritus there is in the lower Wandle, any lack of disturbance of that detritus may considerably prolong the period required for discharge to a level of toxicity acceptable to the full range of benthic plants.

It would be interesting, even though (unlike the Tame-Trent balance) the volumes of Wandle and Thames are different by several orders of magnitude, to monitor over the next few years the river and aquatic flora conditions in the Thames immediately around, and up the tributary river from, the Wandle outfall to the major channel.

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Book Reviews

Birds in Medieval Manuscripts. By Brunsdon Yapp. British Library, London. 1981. 190 pp. £9.50.

With the spate of field identification guides dominating the bird-book market, this more thoughtful production is a welcome change. Brunsdon Yapp has stated an aim of this book is to show the ornithologist of today the medieval view of birds. To approach this task he has divided the book into two parts. Firstly the bird families are reviewed in the groups understood by the medieval naturalist: the groups being such as cranes, owls and sea-birds. Secondly there are 48 carefully described colour plates of medieval manuscripts.

The British manuscripts might be expected with the remote monastic communities to show a good number of sea-birds, but after the destruction of Lindisfarne the sea-birds are rarely illustrated. The accuracy of the birds depicted in manuscripts reached its climax in Britain in the early years of the 14th century, and on the continent about a hundred years later. In this virtually uncharted sphere of our history and ornithology Brunsdon Yapp has the difficult task of tracing the changes in bird art as representation or mere adornment.

A study of the plates will, apart from providing pleasure, do no harm to field identification skills. I would make special mention of the chough depicted in 10 from the Holkham Bible Picture Book. How was an East Anglian artist able to depict a chough so clearly?

The claim for the Renaissance is that the artist's eye was opened to the reality of nature. Certain of these manuscripts suggest their artist was merely copying his predecessor or his provided models. The difficulty in deciding whether or not an artist actually drew the bird he depicted is best encapsulated in "This is probably intended to be a stork but the artist has drawn a bad crane". Had the artist ever seen either bird?

In reviewing this book I cannot speak for the art historian. The general reader should find much of interest. Has the aim of showing the ornithologist of today how the medieval world saw their birds been achieved? Mr Yapp has to disentangle the approach and knowledge of medieval art from the skill of the individual artist. This is a vast and well-attempted task. I hope further researchers will be as fruitful.

As book prices escalate it is also welcome with this volume to praise the production. The colour reproduction is good and the presence of a good index a pleasure. Mr Yapp and the British Library are to be highly complimented.

H. M. V. Wilsdon

Wings and Seasons. By Gunnar Brusewitz. Published by Wahlström and Widstrand, Stockholm, distributed by Croom Helm, London. 1981. 118 pp. £12.95.

The author, living beside a lake in Sweden, has a desire, he says, to share the beauty and interest of his surroundings with other naturalists. This certainly he succeeds in doing; with an economy of pencil strokes and a wash of water colour, he brings his environment to life in this lovely evocative book.

Too large to be carried, this book nevertheless is suitable for reading in bed and for creating the atmosphere of contemplation and quiet nostalgia that is so relaxing in the time before sleep comes.

Mostly an observer of birds, the author describes vividly the spring arrival of migrants in his area of Sweden and of their settling down to breed. A lovely present to give your friends or yourself.

O. L. Cassie

Perforatella, a genus of Palaearctic snails newly recognised in Britain, is found in the London Area

by FRED NAGGS*

Specimens of a mud-dwelling snail were collected in June 1982 by Bernard Verdcourt of the Royal Botanic Gardens, Kew, during an investigation of a Site of Special Scientific Interest in a marshy area of Syon Park (Verdcourt 1982). He was not satisfied with his identification of the snails as *Trichia* and sent a specimen to Dr L. Forcart in Basel who identified it as *Perforatella rubiginosa* (Schmidt).

Although the hairy shells of *P. rubiginosa* and some *Trichia* species are at least superficially very similar (Kerney and Cameron 1979), mature individuals of *P. rubiginosa* do not develop an internal lip on the aperture as in *Trichia* and their reproductive organs are very distinctive. Thus the records of a fossil specimen of *P. rubiginosa* from the Icenian Crag of Southwold (Kennard and Woodward 1899; Harmer 1914; Verdcourt 1982) must be discounted as, after this specimen was cleaned ultrasonically, a distinct apertural lip could be seen.

Trichia contains a number of poorly understood taxa and this would also seem to be the case with snails presently known as *P. rubiginosa*. Specimens of *Perforatella* I collected by the Thames in Oxfordshire (Naggs 1982) are morphologically distinct from the *Perforatella* found in Syon Park, as are specimens collected by Quick from Berkshire (Quick 1960) which he referred to as *Hygromia liberta,* but which I have identified as *Perforatella*. The populations I sampled also completed their annual life cycle in a different phase and when the continental populations of *P. rubiginosa* are examined they exhibit different ecologies. For example, the stenoecious habit of freshwater intertidal populations from Belgium (Vader 1977) may represent a more restricted taxon than records from eastern Europe which may include more than one taxon rather than a single euryoecious species. I am presently engaged on a study of the taxonomic status of both *Perforatella* and *Trichia* in England and hope to clarify some of the biological and nomenclatural problems involved.

Acknowledgement

I am grateful to John Bebbington for allowing me to examine material from the Quick Collection at Juniper Hall Field Studies Centre.

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The Ecology of Dartford Creek and the Thames Estuary near Dartford, Kent

by BRIAN KNIGHTS* and IAN R. CUNNINGHAM*

Summary

The ecology and physiography of Dartford Creek and the Thames near Dartford, Kent, are typical of the mixo-mesohaline mud reaches of an estuary. Physiological stresses keep biotic diversity low on the muddy shores but high inputs of organic detritus support high densities of tolerant species such as the ragworm *Neanthes (Nereis) diversicolor*. Distribution of the latter varied with stability, interstitial salinity and water and organic content of the muds along the Creek. Biotic diversity was raised in summer by migrants from the lower estuary and nearby brackish marsh ditches and was generally greater high on the shore, especially on local saltmarshes. Plans for constructing a marina fronting The Saltings need to take into account their ecology and the processes of marsh formation and succession. Water quality was relatively high, despite local thermal and organic pollution from a paper mill, and evidenced further improvements in the quality of the Thames. Conditions in the Creek should be suitable for passage of migrating salmon and the biota are unlikely to be much affected by a temporary closure of the Creek's tidal barrage.

Introduction

Dartford Creek flows northwards into the Thames approximately 30 km downstream of London Bridge (Figure 1). It is formed by the confluence of the Rivers Cray and Darent. Freshwater stretches of the former have been studied by Knights *et al.* (1980) and Thames Water Authority regularly sample both rivers (Aston and Andrews 1978). Andrews *et al.* (1982) have published data on the fauna of the Thames Estuary and the algae have been studied by Tittley and Price (1977) and Price (1982). Little detailed information is available, however, for the area chosen for the present study. It is situated in the mixo-mesohaline or 'mud-reach' region of the estuary where average salinity at mid to high tide is about 30-50% of seawater. Large quantities of mineral and organic particles enter this region from the upper Thames and from tributaries and are retained for a time as freshwater discharge is balanced by tidal ebb and flow. The exact position of the zone and retention time will depend on magnitude of river discharge; retention time is normally between 22-88 days (Gascoine and Wildish 1971) but, for example, would have been much longer during the drought of 1976 when river discharge was exceptionally low and salt water penetrated high up the estuary (Andrews 1977). Fine particles settle out as water velocity slows, especially high on the shore as the estuary is filled by the rising tide. Salt flocculation accelerates accretion and extensive mud banks are formed. Erosion and low salinity deflocculation occur as the tide retreats and sediments, especially low on the shore, are reworked, rendering the substratum unstable and turbidity high (and hence light penetration low). Retention of organic detritus leads to eutrophication and a potentially high BOD and low DO (i.e. an 'oxygen sag'), conditions possibly exacerbated by effluents from Beckton and Crossness Sewage Works just upstream.

The above factors, coupled with the varying salinity and tidal exposure, render the area biologically very stressful and worthy of detailed study. Furthermore, the area includes one of the few high-shore saltmarshes in London. Entrainment between banks has made the Thames narrower and faster flowing and marsh sediments can only accumulate in areas protected from the main erosive flow, as

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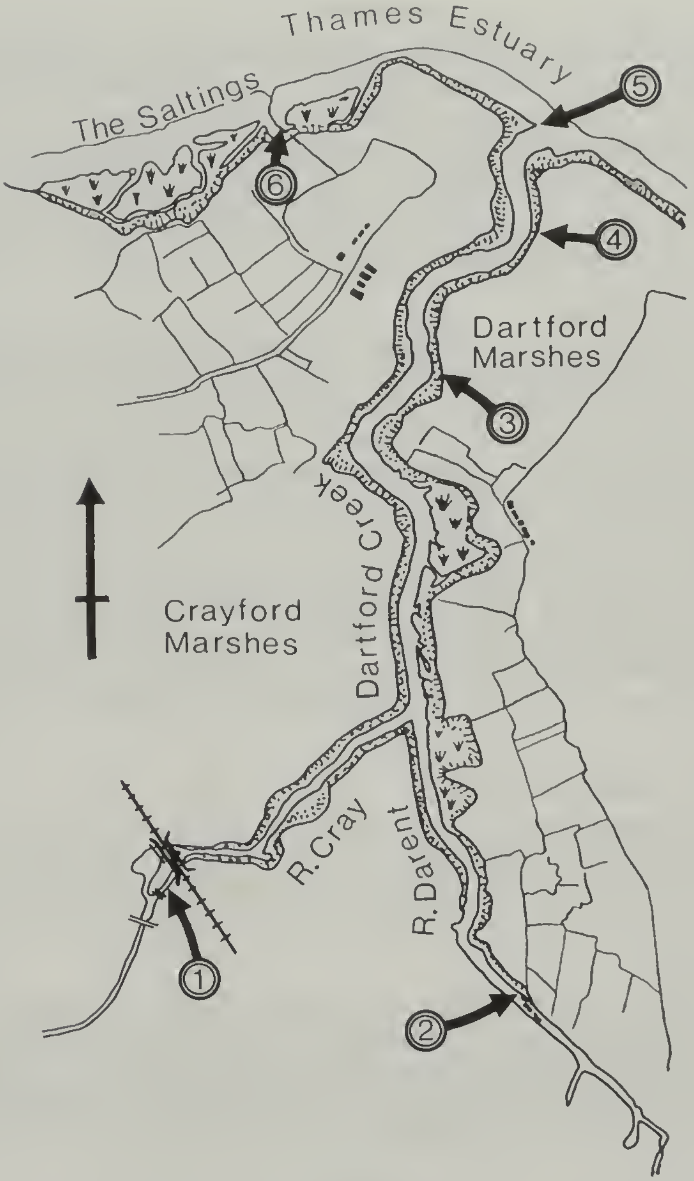

FIG. 1. Map of study area showing sampling stations.

at The Saltings near Crayford Ness and in embayments along Dartford Creek (Figure 1). Other London marshes have largely been enclosed and drained (as with the nearby Crayford and Dartford Marshes) or they have been reclaimed and built on to form wharves, etc. Possible future development of a marina on The Saltings (Bexley Borough Council 1981) make a study of their ecology particularly pertinent. In addition, the Darent could be an important spawning river if salmon were to be reintroduced to the Thames system and migrations would have to occur via the Creek. Thus it is of interest to assess the ecological and pollution status of the Creek compared to the Thames and the two tributaries. Finally, a tidal barrage is being constructed across the Creek to protect Dartford from flooding if it ever became necessary to close the main Thames barrage upriver when water levels could reach dangerous heights in the lower estuary. Closure of the barrage would cause the Creek to fill with extra fresh water from the Cray and Darent and the possible ecological impacts of this need assessing.

Methods

The entrained stretch of the R. Cray below its weir (Station 1, Figure 1) and the Thames foreshore near to the sluice from Crayford Marshes (Station 6) were the only sites with safe and easy access for regular sampling. These were visited once a month at mid to high-tide between November 1979 and October 1980. To check that the fauna of the Thames foreshore was representative of the lower reaches of the tributaries and the Creek (Stations 1 and 2 and 3 to 5 respectively, Figure 1), sampling was carried out along the shores of the latter in October 1979 to March 1980 wherever safe access could be gained across the soft steep mudbanks.

Physicochemical factors

Salinity temperature, DO, BOD and suspended solid loads can change rapidly, depending on tide, weather and river discharge. Intensive sampling at all Stations at every visit was not possible but the first three factors were measured on almost all visits to Station 6. Surface water samples were collected using a weighted bottle at high tide at Stations 1 to 5 on four occasions between October 1979 and March 1980 for analysis of all these factors. To assess changes during a tidal cycle, salinity and suspended solids were measured in surface and bottom water samples collected in October 1979 from the catwalk built over the Creek during barrage construction (i.e. Station 4). The weighted sampling bottle had only small holes for entry of water and exit of air and thus could be lowered to the required depth before any appreciable filling occurred. Finally, samples taken along the Creek in February 1980 were also analysed by atomic absorption spectrophotometry for heavy metal pollution (i.e. zinc, lead, copper and chromium) and pH was also measured.

Nature of the Creek muds

Neanthes (Nereis) diversicolor was found to be the predominant species in the intertidal muds and its distribution was compared to interstitial water, and organic content and salinity in mud samples collected along the Creek in March 1980.

Flora and fauna

The characteristic flora at each site was noted. To make approximate estimates of the relative abundance of the macrofauna, the benthos was sampled over 3 minutes with an FBA pond net, the meiofauna was sampled by scraping off about 0.3 m^{-2} of the mud surface with the net or a kitchen sieve and a similar area was dug out with a spade where possible to extract the deeper burrowing infauna.

Results

Physicochemical factors

Mid to high tide salinity in the Thames and Creek mouth varied between 4.5 and 32‰, the average of 18.5‰ being close to that quoted by Tittley and Price (1977) and slightly more than the half-tide average of 12‰ given by Andrews *et al.* (1982). Salinity at high tide was only slightly reduced in the Darent just below the weir and lock (Table 1) but freshwater was penned back in the narrow entrained section of the Cray before the railway bridge. A typical tidal pattern of salinity changes in the outer Creek (Station 4, Table 2) shows that the freshwater discharge from the tributaries markedly dilutes estuarine water and that draining from the muds and marshes in the bottom of the channel only at low tide. A vertical gradient occurs at this time with the fresher and less dense water tending to rise up over the denser more salty water. As the tide floods, the incoming estuarine water then rises over the more mixed and less saline water and a reverse saline wedge exists for about 2 hours until complete mixing occurs and the river waters are pushed back. These results show that the Creek can be best considered as an arm of the Thames.

TABLE 1. Average mid to high tide values for various physicochemical parameters between October 1979 and March 1980 (Stations (1a) and (2a) represent above-weir samples from R. Cray and Darent respectively).

	Station No.							
	(1a)	1	(2a)	2	3	4	5	6
Salinity ‰	(0)	4	(0)	11	13	14.5	14.5	18.5
Temperature °C (Air = 7.5°C)	(6.5)	7	(6.5)	12	10	6	6.5	6
Suspended solids mg l^{-1}	(70)	103.5	(76.5)	113.5	123.5	546.5	280	—
DO mg O_2 l^{-1}	(11.3)	10.2	(11.2)	9.4	—	7.5	—	6.5
DO % saturation	(80.5)	83	(80)	92	—	82.5	—	72
BOD mg O_2 l^{-1}	(3.0)	3.0	(2.0)	8.9	—	2.1	—	—

TABLE 2. Changes in salinity profile and suspended solids from low to high tide at Station 4 on 10 October 1979.

	Low Tide 11.00	12.00	Time 12.30	13.00	14.00	High Tide 15.30
Surface salinity ‰	3	8	10	13	14	16
Bottom salinity ‰	6.5	5	4	13	14	16
Suspended solids mg l^{-1}	2650	2905	550	580	800	850

Water temperatures changed with season (Tables 1 and 2) but were raised by up to 4.5-6.0°C at Station 2 by warm effluents released by the nearby paper mills at high tide.

Suspended solids showed a reverse pattern to salinity, highest loads being carried at Station 4 between low tide and the early flood (Table 2). Levels rose from 2650 to a maximum of 2905 mg l^{-1} on 10 October 1979. This correlated with low salinity deflocculation, drainage from the mud banks and marshes and increases in water velocity. Water velocity and erosion were accentuated at this Station by the constriction of the channel by the barrage caissons. Loads decreased to a minimum at high tide as accretion occurred again. Most of the sediments were derived from the Thames since the average load in the Creek mouth was 280 mg l^{-1} whereas those in the Cray (Station 1a) and Darent (Station 2a) were only 70 and 76.5 mg l^{-1} respectively (Table 1).

Dissolved oxygen and BOD correlated well with salinity and suspended solids (Table 1); DO was lowest at Stations 4 and 6 where high salinity and suspended solids reduced oxygen solubility. Taking salinity and temperature into account, however, the percentage saturation was still above 72%. BOD's were quite low, 2-3 mg l^{-1}, except at Station 2 where high tide BOD was much greater (e.g. approaching 9 mg l^{-1} on 14 February 1980). This suggests that suspended solids were largely inorganic except at this Station where the paper mill effluent must have a high biodegradable organic content. Considerable dilution must occur at high tide, however, because this effect, like that of the high effluent temperature, is not maintained downstream. The average high tide oxygen saturation at Station 6 over the year was 77% and the summer quarter average was 75% (Table 3). The latter indicates a further amelioration in oxygen sag compared with TWA half-tide averages just below Beckton and Crossness Sewage Works of zero in the

1960's, about 10% in the mid 1970's and 50% in 1980 (Cockburn 1979; Andrews and Rickard 1980). These changes have been the result of reductions in oxygen demand of the sewage works effluents following improvements in treatment and plant capacity.

TABLE 3. Three-monthly averages for various physicochemical parameters for morning mid to high tide samples from the Thames foreshore (Station 6) between November 1979 and October 1980.

	Nov.-Jan.	Feb.-April	May-July	Aug.-Oct.	Annual average and (range)
Temperature °C	6.5	7.5	18.0	16.5	12.0 (5-19)
(Air Temp °C)	(7.0)	(7.5)	(20.0)	(16.5)	(12.5) (3-21)
DO % saturation	71.5	75.0	83.5	73.0	76.0 (70-100)
Salinity ‰	23.5	19.5	17.0	15.5	18.5 (4.5-32)

TABLE 4. Distribution of *N. diversicolor* along Dartford Creek in relation to interstitial salinity, water content (% loss of weight on drying) and organic content (% loss of weight on ignition) of muds on 13 March 1980.

	Position of sampling point relative to Station No.							
	2				3		4	5
N. diversicolor:-								
Density (no. m^{-2})	0	262	131	283	162	68	91	0
Total wt. (g m^{-2})	0	28.8	28.8	73.6	53.3	13.0	15.5	0
Average weight (g individual^{-1})	0	0.11	0.22	0.26	0.33	0.19	0.17	0
Mud interstitial:-								
Water content %	42	47	39	47	48	38	31	26
Salinity ‰	7	7.5	10	9.5	13	14	15	17.5
Organic content %	15	18	17	15	17	16	18	7.5

Large amounts of water are retained by the fine sediments deposited in the Creek, 40-50% loss of weight of samples occurring on drying (Table 4). Water content was lowest at Station 5 because the strong currents in the Thames prevent the settlement of fine water-retaining sediments and the substratum consists of hard muds, sand and gravel. Interstitial salinity mirrored the average salinity in each region, increasing from 7 to 17.5‰ along the Creek. The sediments towards the bottom of the river channels might be less saline because they are exposed to fresh water discharge at low tide. Organic content of the muds was relatively constant along the Creek at 15-18% loss of weight on ignition, except at Station 5 where deposits are more coarse and inorganic, as discussed above. Results for the Cray are not shown but levels were low in the scoured entrained region and then rose in the mud-reaches downstream of the railway bridge (e.g. from less than 8% to more than 15% on 13 February 1980).

The pH range between Stations was small, increasing from 7.6-7.7 in the freshwater tributaries to 8.1 at Station 5 on 14 February 1980. Heavy metal concentrations in the water were low, averages for the Creek and, in brackets, the tributaries being; zinc, 0.025 (0.018) mg l^{-1}; lead, 0.011 (0.011) mg l^{-1}; copper, 0.017 (0.010) mg l^{-1}; chromium, 0.001 (0.001) mg l^{-1}. Levels tended to be highest near to the paper mills and in the Thames, but differences were very small and probably within margins of analytical error.

The flora of the tributaries, Creek and Thames foreshore

Low shore mud banks were too unstable to support any macroflora. The stony bottom of the entrained part of the Cray supported euryhaline *Enteromorpha* sp. and occasional mats of *Cladophora* sp., however. The entraining walls were covered in the green algae *Blidingia* sp. up to the mean high tide level. Tittley and Price (1977) also found *Blidingia* to be dominant on such surfaces at comparable low salinities (i.e. about 2-7‰ in the Thames upstream of Woolwich. *Blidingia* also appeared on the upper revetments on the Thames foreshore at Station 6, but graded into indistinct lower zones of *Rhizoclonium riparium* and *Enteromorpha* sp. and then the brown algae *Fucus spiralis*. Below this level *Fucus vesiculosus* occurred where there were stones or other suitably firm substrata for attachment. Clumps of the green alga *Ulva lactuca* were also found, especially if there was any fresh water run-off. All these species are tolerant of aerial exposure and varying salinity. The fucoids, especially *F. spiralis*, were found to be near their upriver limit at Crayford Ness by Tittley and Price (1977), but more recent work (Price 1982) shows further extension westward. Stunting indicates low salinity and high turbidity stresses, however.

The vertical zonation of plants on the saltmarshes was fairly typical of the expected pattern of colonization and haloseral succession (Randerson 1979). Low level muds support microalgae, which help to consolidate the substrata, plus some *Enteromorpha, Ulva* and *F. vesiculosus*. These slow water currents further and encourage sedimentation and a rise in mud level, creating conditions suitable for colonization by the halophytic *Spartina anglica*. This hybrid species was first found in Britain late in the last century but has only advanced this far up the Thames in the last few decades (Foster 1972). *Spartina* further accelerates accretion and minimises erosion and land levels rise further until the marshes are only covered by the highest tides and conditions become suitable for less halophytic species. The Saltings and Creek marshes are fairly mature and further succession is limited by the sea walls behind them. The early pioneer species and stages are limited to areas where accretion is still tending to be balanced by erosion, i.e. on the outermost fringes of the marsh or in incised tidal drainage creeks and isolated saline pools or mud pans (Kestner 1979). The higher levels support halophytes such as *Puccinellia maritima* and, especially, *Cochlearia anglica* and true grasses, *Agropyron pungens* and *Festuca rubra* appear at higher levels still. Other halophytic species were also found on the marshes and elsewhere in the paramaritime zone (e.g. on the revetments and crests of sea walls), e.g. *Aster tripolium, Glaux maritima* and *Triglochin maritima*. All these species have been reported previously in this area by Foster (1972).

Macrofauna

Twenty-nine species were found in the tidal R. Cray but 10 were estuarine species found at other Stations and 19 were freshwater species typical of the upper Cray (Aston and Andrews 1978; Knights *et al.* 1980). The latter had probably been washed over the weir and could not have formed breeding populations and are therefore not discussed further. All the euryhaline species (except for elvers of *Anguilla anguilla* and larvae of plaice *Pleuronectes platessa*) were found in the more intensive study at Station 6 and only the latter results are to be discussed in detail.

Table 5 shows that the benthic macrofauna at Station 6 was dominated by mobile crustacean detritivores and scavengers, notably the mysid *Neomysis integer*, the shrimp *Palaemonetes varians* and two species of *Gammarus*. Maximum diversity and abundance occurred in the summer, *N.integer* being particularly abundant in June-August. Only *Gammarus zaddachi* was moderately abundant throughout the year. The eggs and larvae of most other species are not very tolerant of low salinity and thus main population growth and upstream migration follows breeding in the lower estuary in spring and summer. This is certainly true of *Neomysis*, the shore crab *Carcinus maenas*, the common goby *Pomatoschistus microps*, and young flounder *Platichthys flesus*. Many other fish show such summer migrations and perhaps use the estuary as a nursery ground (Andrews *et al.* 1982) but would not have been expected to be adequately sampled by the methods used in the present study.

Table 5. Changes in relative abundance of species found at Station 6 (mid to high tide) between November 1979 and October 1980 (showing three-monthly totals of individuals of each species).

	Nov.-Jan.	Feb.-April	May-July	Aug.-Oct.	Annual Total
ANNELIDA:					
POLYCHAETA					
Neanthes (Nereis) diversicolor	1	1	5	18	25
MOLLUSCA:					
PROSOBRANCHIA					
Potamopyrgus jenkinsi	1	8	5	5	19
ARTHROPODA:					
CRUSTACEA					
Gammarus duebeni	—	54	60	13	127
G. zaddachi	14	42	5	10	71
Palaemonetes varians	2	2	42	117	163
Crangon vulgaris	—	—	14	5	19
Pandalus montagui	—	2	—	—	2
Neomysis integer	—	—	1020	97	1117
Sphaeroma rugicauda	—	1	—	1	2
Ligia oceanica	—	1	—	1	2
Corophium volutator	2	24	—	22	48
Carcinus maenas	—	—	4	1	6
VERTEBRATA:					
PISCES					
Gasterosteus aculeatus	2	2	15	8	27
Pungitius pungitius	—	—	2	—	2
Pomatoschistus microps	—	—	13	11	24
Platichthys flesus	—	—	1	1	2

Gammarid species show a zonation in estuaries according to their salinity tolerance, *G. duebeni* usually being more abundant upriver and at a lower salinity than *G. zaddachi* (Andrews 1977; Andrews *et al.* 1982). *G. duebeni* was numerically the most abundant over the year at Station 6, however, but only because of its summer population explosion. This was probably largely due to migration from the large breeding populations in the ditches on Crayford Marshes where salinity is less than 5‰ (Knights and Powlesland in prep.) *G. duebeni* is tolerant of aerial exposure and might furthermore be expected to be more successful high on the shore.

Of the other species found, *Sphaeroma* and *Ligia* are typical high shore/saltmarsh isopods. The ragworm *Neanthes (Nereis) diversicolor, Corophium volutator* and *Potamopyrgus jenkinsi* are euryhaline species well adapted to life in or on estuarine muds. They were fairly common on the mud-banks to either side of the sluice at Station 6 and were the only species found along the mud-reaches of the rivers and Creek. They feed on surface detritus and bacteria. *P. jenkinsi* is very well adapted to low salinity and is displaced further downstream by *Hydrobia ulvae* (Andrews *et al.* 1982). It has even invaded freshwater and is abundant in the nearby marsh ditches (Knights and Powlesland in prep.). *N. diversicolor* is reaching the limit of its upriver penetration in the study area where the interstitial salinity of muds approaches 30% that of seawater (Table 4). Abundance was highest in the Creek between Stations 2 and 3, biomass and average size increasing with increasing interstitial salinity. Many individuals lived under stones high on the shore at Station 6, making it very difficult to quantify them accurately. The data in Table 5 suggest, however, that individuals are found higher upstream and that densities increase in the summer following spring spawning, as was the case in the Medway Estuary (Wharfe 1977). Very few worms were found lower on the shore because of increasing scour and instability and the same pattern was repeated towards the mouth of the Creek (Table 4), correlating with the fall in organic and interstitial water content in this region noted previously. Gee (1961) also found *N. diversicolor* (and *Corophium volutator)* preferred more stable and silty high shore muds in South Benfleet Creek, Essex. These two species, plus *Carcinus maenas,* were in fact the only ones common to both studies because the salinity in South Benfleet Creek was higher (27.5 5-32.2‰) which favoured more marine species of annelids, molluscs and crustaceans. All the macroinvertebrates discussed above were found in this region of the Estuary by Andrews (1977) and Andrews *et al.* (1982), with the addition of *Orchestia gammarella.* Tubificid worms, especially *T. hostatus,* used to dominate the mud reaches (Hunter 1981) but decreasing organic pollution and increasing DO have encouraged their displacement by the species discussed above (Harrison and Grant 1976, Wheeler 1979, Andrews *et al.* 1982).

Discussion and Conclusions

The physiography and biota of the study area are fairly typical of the meso-mixohalocline mud reaches of an estuary and the Creek can be considered primarily as an arm of the Thames. The biota are well adapted to the attendant variations in salinity, sedimentation, turbidity, DO, temperature and, for intertidal species, tidal immersion and emersion. Salinity tolerance of *N. diversicolor* was tested by the authors and no mortalities occurred after 6 hours at 4 or 13°C in solutions of 0 to 100% seawater. They would therefore be little affected if the barrage had to be closed during the peak of a storm surge tide and salinity of the Creek fell. Even the less euryhaline tidal migrant species could probably survive such a period because stratification would occur and they could remain in the denser more saline water in the bottom of the Creek.

Species diversity (except at the aberrant Station 1 on the Cray) was low because of the environmental stresses imposed and, at least on the lower shore mud-banks, the low number of available ecological niches. Greater diversities were found on the higher shores and saltmarshes or were due to summer migrants from the lower estuary (e.g. various crustaceans and fish) or from Crayford Marshes (e.g. *Gammarus duebeni* and sticklebacks). Diversity is possibly low in N.W. European estuaries because euryhaline species have only had about 10,000 years in which to evolve since the estuaries were formed in the last Ice Age; dispersal within and between estuaries is also slow because of the tendency towards suppression of a planktonic larval stage (McLusky 1981). The large breeding populations of *G. duebeni* on Crayford and Dartford Marshes may, for example, have been isolated since enclosure of the marshes. Further evidence of such isolation is that *G. zaddachi* is absent from the Medway Estuary, although *G. duebeni* and all the other euryhaline species found are present (Wharfe 1977).

Although diversity may be low, densities can be high in the mixo-mesohalinicum because of the high inputs of allochthonous organic detritus from the Thames and tributaries, plus some autochthonous detritus from the few areas of saltmarsh. Primary production may be important on the saltmarshes but most of the primary consumers will be terrestrial herbivores (Gray 1979). The Estuary and Creek are primarily heterotrophic systems dominated by relatively few species of mobile detritivore-scavengers such as *N. diversicolor, P. jenkinsi* and crustaceans such as *Corophium, Neomysis* and the gammarids. Secondary consumers are mainly represented by the migrants such as the flounder and goby and terrestrial species such as birds. The latter were not studied in detail, but gulls and various wading and dabbling birds were commonly seen in the area.

The study revealed no evidence of marked pollution other than occasional oil slicks but large quantities of industrial and urban debris were stranded on the high shore. Heavy metal levels and BOD's were quite low and DO high, indicating further reductions in pollution of the Thames compared with the data of Cockburn (1979) and Andrews and Rickard (1980). The temperature and BOD of the paper-mill effluents entering the Darent appear high, but these effects are rapidly diluted when discharge is at high tide. They did not discourage migration of elvers in late spring and summer (BK, personal observation) and, except under exceptional circumstances, should form no significant barrier to possible future salmon migrations.

The Saltings is a high level and mature saltmarsh with only the fringes and drainage channels being representative of earlier stage in succession. Any development to form a marina should preferably avoid full reclamation and infilling and hence total loss of marsh and paramaritime habitat (Gray 1979). Little change need occur if development is carried out sympathetically. Extra pilings, jetties, etc., could in fact interfere with currents and the balance between accretion and erosion (Kestner 1979) which could lead to further marsh development, resulting in a gain of habitat rather than a loss.

Acknowledgements

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Hemiptera-Heteroptera of the London Area

PART XIII

by Eric W. Groves*

(Previous parts of this paper have appeared in *The London Naturalist* as follows: Pt. I (**43:** 34-66, 1964); Pt. II (**44:** 82-110, 1965); Pt. III (**45:** 60-88, 1966); Pt. IV (**46:** 82-104, 1967); Pt. V (**47:** 50-80, 1968); Pt. VI (**48:** 86-120, 1969); Pt. VII (**50: 87-94, 1972**); Pt. VIII (**52:** 31-59, 1973); Pt. IX (**54:** 21-34, 1975); Pt. X (**55:** 6-15, 1976); Pt. XI (**56:** 32-43, 1977); and Pt. XII (**61:** 72-87, 1982). A continuing list of abbreviations as to sources of records and for recorders' names has appeared whenever appropriate at the beginning of the parts listed above and new additions to these are now given below.)

SOURCES OF RECORDS

The following are new sources of records:

(a) Published and manuscript:

31. *Entomologist's mon. Mag.* **1:** 1864 →
    (i) LESTON, D. 1955. Miscellaneous biological notes on the British Corixidae & Notonectidae, **91:** 92-95.
    (j) LANSBURY, I. 1954. A further record of *Corixa (Corixa) dentipes* (Thomson) (Hem. Corixidae) from Barnet, Herts. **90:** 168.
    (k) LESTON, D. 1953. Corixidae (Hem.) at ultra-violet light in Middlesex, with remarks on migrations. **89:** 291.
32. *Entomologist* **1:** 1840-1842, 1864 →
    (g) BROWN, E. S. and SCUDDER, G. G. E. 1958. Notes on the rarer British species of aquatic and semi-aquatic Hemiptera. III. *Micronecta minutissima* (L.). **91:** 15-19.
    (h) LANSBURY, I. 1961. Hemiptera-Heteroptera Corixidae at light in Hertfordshire. **94:** 137-143.
67. *Trans. Soc. Br. Ent.* **1-19:** 1934-1971.
    (d) WALTON, G. A. 1938. The British species of *Micronecta* (Corixidae, Hemipt.) **5**(7): 259-270.
75. NAU, B. S. 1974. A distributon study of aquatic Heteroptera in Hertfordshire. *Trans. Herts. nat. Hist. Soc. Fld Club* **26**(7): 307-320.
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77. Personal records of L. Jessop (from Essex).
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82. Manuscript field notebooks of C. P. Castell (on Bookham Common, Surrey).
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INDEX TO RECORDERS' NAMES

The following are abbreviations to recorders' names additional to those already listed in Parts I-VI and XII:

Robert Adkin	*(RA)*	L. Jessop	*(LJ)*
J. A. Boyer	*(JABo)*	Walter Johnson	*(WJ)*
T. F. Clarke	*(TFC)*	M. W. Joyce	*(MWJ)*
E. W. Classey	*(EWC)*	E. J. Pearce	*(EJP)*
J. E. Downes	*(JED)*	C. D. Routh	*(CDR)*
J. L. Harrison	*(JLHa)*		

COUNTY BOUNDARIES USED IN THE PRESENT SERIES

Although a definition of the boundaries used in this present series of papers was given in Part I *(Lond. Nat.* **43:** 35 (1964)) it may be as well to repeat it. Previous British Heteroptera distribution lists have all been on a county basis, as opposed to botanical records which historically have been based on the Watsonian Vice-County system. This list therefore follows the precedent already set and the boundaries of the counties north and south of the Thames that lie within the Society's 20-mile radius from St Paul's Cathedral are those existing prior to 1889, i.e., the date when the London County administrative area was formed from corners carved out of adjacent counties.

NEPIDAE

There are two British species in this mainly tropical family of bugs; both have been recorded in the London area.

Nepa cinerea Linn. Water Scorpion Sp.468 p.361
D & S p.584 S p.327 B p.544 (Sp.327)

Common. Occurs on the bottom of ponds and muddy lakes throughout the London area. Eggs are laid soon after mating, which occurs from the beginning of April to the end of May. The bug passes through five larval instars during the following six to eight weeks and all are usually adult by mid-August. The front legs of this flat-bodied, dark brown bug are much modified (like a scorpion's claws) for catching small aquatic prey. The thin tail forms the respiratory organ which takes in air when the bug swims, or climbs up weed, from the bottom to a resting position upside down just below the surface. The adults are sometimes found covered with red larvae of a hydrachnid mite *Hydrobia globosa.* Bucks. records required.

Middx. Hampstead, 1884-88, *FAW* (23); Hampstead Health, 1949, Viaduct Pond, *DL* (1/**1949-50,** 36-38 and EMM **95,** 253); Ponders End, 17.xi.42, in pools, *ESB* (HD); Enfield (Beech Hill Park lake), 8.iii.53, 25.viii.53, *IFL* (71); 25.ix.53 (adult) *IFL* (71); 25.ix.53 (V instar larva) *IFL* (BM) (71); South Mimms (Mimms Wash Stream), 13.v.54, one ♂ & one ♀, *IFL* (71); Cricklewood, 1892, n.c. (BM); Ruislip LNR, viii.64, a few larvae found in the New Pool, *WFS* (49); near Harrow, 23.iv.56, in pond, *MWJ* (BM); pond near Cranford, 5.vii.31, *EJP* (67b); Perivale, viii.63, pond in the Selborne Society's sanctuary, nymph, *PSB* (16); and Boston Manor, 28.vi.42, *HStJKD* (HD).

Herts. Barnet (Hadley Green), 7.iii.48, two adults, *IFL* (BM); 16.vii.49 (III instar larva), 16.x.49 (adult), 5.ix.51 (III instar larva) and 2.v.52 (adult) all records of *IFL* (BM); in large pond, 6.v.53, 25.viii.53 (adult & 4 larvae), *IFL* (71) (BM); in another larger pond, 23.iv.53 & 25.ix.53 (both adults) (BM); Monken Hadley (Hadley Common), 22.ii.53, 6.v.53, and 25.ix.53 (adults & larvae), in small shallow pond with clay bottom and much detritus, *IFL* (71) (31j); Rickmansworth, 15.viii.16, adult & III instar larva, *EAB* (BM); Colney Street, 1.x.71, in the shallows of the River Ver, one juvenile amongst watercress, *BSN* (58); Brickenden Liberty (Ettridge Farm), 1.v.71, 4 adults in green water of farm pond, *BSN* (58); Cheshunt (Lea Valley marshes), 5.ix.57, a single adult dredged up, also from muddy ditches on previous occasions, *AAA* (51); Rye Meads (NL/Lea Marsh), 19.iv.62, a single adult in dyke, *BSN* (58); (NL 9 effluent lagoon), 19.iv.64, a single adult eating a worm, *BSN* (58); (pool N.E. of Standstead Abbots gravel pit), 22.viii.71, a single immature adult in rich gravel pit pool, *BSN* (58); between Rye Meads and Stanstead Abbots, 30.v.66, a single adult in gravel pit, *BSN* (58); Lemsford Springs, 20.vi.71, in roots of fallen willow at river margin, *BSN* (58); Haileybury, 12.v.38, from pond in the Master's garden in the college, *ESB* (HD); and just over the boundary at Boxmoor, 8.x.45, in thick weeds at edge of streamlet parallel with old canal, *BV* (EMM **85**, 249-253); and at Symondshyde S.E. of Wheathampstead 10.x.71, one adult and one immature specimen in rich pond, *BSN* (58).

ESSEX. Walthamstow, n.d. [prior to 1923], *CN* (35a); Woodford, 14.viii.25, IV & V instar larvae, *EAB* (BM); South Woodford, vi.18, I instar larvae hatched from egg. *EAB* (BM); Buckhurst Hill, 2.ix.25, III & IV instar larvae, *EAB* (BM); Epping Forest, 16.ix.63, *PSB* (16); (Chingford), ix.12, III instar larva, *EAB* (BM); (Fairmead Bottom), 14.v.52, Pond C, *IL* (BM); (Loughton), ix.1894 & 1.x.10, *EAB* (BM); (Wake Valley pond), n.d. [prior to 1923], *CN* (35a); iv.63, larva, *PSB* (16); 5.viii.40 (9 larvae) *ESB* (67a) (HD); 3.ix.40 (a few larvae), *ESB* (67a); Stifford near Grays, 11.viii.79, *LJ* (77); Stanford le Hope, 25.vii.55, *KCS* (14); and beyond the boundary at Benfleet, 1.vii.61, *SL* (1/**1961**,82).

KENT. Brockley, *WW* (39); Blackheath (garden pond at 63 Blackheath Park), first detected as larvae 9.vi.63 & 1.viii.63, larger ones 26.viii.63 dredged up or when the water had dried out, hiding under dead leaves on the surface of the mud; adults sparingly in 1964-5 in same way but not noticed later, *AAA* (51); Abbey Wood marshes, 15.x.58, in dyke with thick vegetation, *AAA* (51) (22); Lewisham, *WW* (39); (Hilly Fields), *circa* 1860, abundant in old disused brick ponds, *RA* (1/**1934-35**, 127); Lee (Hither Green Lane), 16.v.1896 & 8.iv.1898, pond in field, *WW* (60) (39); Dartford (Princes Road ponds), *circa* 1958, in lakes by the A2 roadway, *KCS* (14) (22); River Darent, 1963, between the head spring and the tributary springs below the ponds, n.c. (69); Bromley, 11.ix.64, *PJC* (63); and on the boundary at Filbro' marshes, Gravesend, 24.ix.48, in ditch, *TRES* (13); and beyond at Higham Marshes, 23.iii.59 & 15.viii.65, *AMM* (70); 2.v.65, *AMM* (1/**1965**, 57) (22).

SURREY. Richmond Park (Pen Ponds), ix.34, adults and larvae, *JAD* (1/**1934-35**, 41); 1934-38, *EJP* (68b); (Leg of Mutton Pond, about quarter mile W. of the Robin Hood Gate), 27.viii.46, *EJP* (68b); Wimbledon Common (Queen's Mere), [prior to 1912], 'abounds in the Mere', *WJ* (79); 'once plentiful in the muddy bottom of Queensmere', *JLHa* (80); (Scio Pond), [*circa* 1937], *JLHa* (81); (Scio Pond and Blue Stream), 1949-51, *AJW* (19); (Stream running from Caesar's Well to Beverley Brook), 24.viii.46, about 50 yards from Beverley Brook, water stagnant, *EJP* (68b); Mitcham Common, 8.iii.52, *LC* (64); Coulsdon, (S. of Devilsden Wood), iii.61, in damp mud of floor of Ditches Lane pond, dried up on this occasion, *EWG* (24); Bletchingly, 7.ix.66, in Hevans pond, *RRF* (66); Limpsfield, 11.iii.45, *CHA* (17); Earlswood Common pond, [prior to 1867], *J & TL* (32); Burgh Heath, i.vii.66, in Marbles pond, *RRF* (66); Mickleham, iii.52, n.c. (SL); Epsom Common (Stew Ponds), 11.vii.14, several in larval stage, *n.c. (Proc. Croydon nat. Hist. sci. Soc.* **8**, xxii.1915); 19.iv.39 & 26.iv.53, *EWG* (24); 6.vii.75, *RRF* (66); 24.v.70, a single specimen in smaller pond, *BSN* (58); 19.iv.39, in small pond S. of lower Stew Pond culvert bank, *EWG* (24); Leatherhead, 11.v.24, V instar larva, *WEC* (BM); Bookham Common, iii.1897, *n.c.* (60); 11.x.42, in IOW pond, *JLHa* (82); 10.ix.44, in Upper Eastern pond, *CPC* (82); 22.iv.46 in IOW ditch, *CJFB* (82); 4.x.47, in Bookham Stream, *CJFB* (82); 29.ix.51, in IOW pond, *DL* (34); 4.v.52 in IOW pond, very common, *DL* (1/**1952-53**, 75) (54); Esher Common (Black Pond), 18.v.01, *SWK* (1/**1901**, 12); Weybridge, 22.ix.63, *PSB* (16); and on the boundary at Woking, 23.v.31, *FJC* (SL) (1/**1931-32**, 64); Horsell, 23.v.31, *FJC* (SL) (62); Brookwood, 8.vi.31, *FJC* (SL) (62); and beyond along the Basingstoke Canal between Pirbright Bridge and Frimley Green, 1954-55, *HDS* (50).

Ranatra linearis (Linn.) Water stick-insect Sp.469 p.363
D & S p.582 S p.328 B p.548 (Sp.428)

Occasional though widespread. This long and thin bug is found in ponds and small lakes where there is emergent marginal vegetation. It spends much of its time resting between blades of weed, its thin body providing the necessary camouflage while it waits for insect prey floating on the surface. The overwintering adults pair from mid-April to July; the eggs taking about 3-6 weeks to develop depending on the warmth of the season. The larvae pass through five instars taking a further two months before reaching maturity. The water stick insect can swim equally well below the surface using its mid and hind pairs of legs as oars in its hunt there for water fleas. Like the last this species often carries the parasitic larvae of the watermite *Hydrobia globosa.* Bucks. records required.

Middx. Hammersmith marshes, n.d. [prior to 1865], *D & S* (28) (36) (37); Ponders End, 17.vi.42, in Quarry pond, *ESB* (HD); Enfield (Wrotham Park), 20.ix.57, adults abundant in large cattle pond with gravelly bottom and thick layer of detritus in some marginal areas, *IFL* (71); Mill Hill, *EAB* (37); Ruislip, 1959, in the Lido, n.c. (49); and at Greenford, 15.iii.01, *SWK* (SL).

Herts. Barnet (Hadley Green), 23.iv.53, a single adult in larger pond, *IFL* (71); Colney Heath gravel pit, 20.ix.47, *ESB* (HD); Cheshunt (Cadmore Lane Gravel Pit), 18.viii.71, two large larvae in *Sparganium* and *Myriophyllum, BSN* (58); (Old River Lea), 18.viii.71, a single adult from amongst dense growth of *Ceratophyllum, Nymphaea* and *Sparganium* in slow river, *BSN* (58); Lea Navigation, 23.vi.65, two larvae from Wormby river edge above Kings Weir, *BSN* (58); Rye Meads Gravel Pit, 24.iii.72, a single adult in rich pool adjacent to the gravel pit, *BSN* (58); Haileybury (Roundings Pond), 9.vi.40 (adult), 14.vii.40 (II, IV, & V instar larvae) & 29.vii.40 (III instar larvae), *ESB* (HD); (Goldings Wood pond), 8.xi.38, *ESB* (HD); and on the boundary at Stanborough Lake, 27.vi.71, a single adult in the mooring bay, *BSN* (58).

Essex. Epping, vi.1790, nymph taken from pool, *E. Donovan* (30)*; n.d., *Enock* (5)(35a); Epping Forest, n.d., *GS* per *Mr Bydder* (29); n.d., specimen 'literally covered with the red mite parasite *Hydrobia globosa* of all sizes', *EAB* (38); (Loughton), 6.i.1885, two ♀♀ 'taken at least a mile from water', *TRB* (1/**1885,** 26) (38); (Wake Valley Pond), n.d. [prior to 1923], *CN* (35a); 3.ix.40, a single adult, *ESB* (HD) (67a); and (Goldings Hill Pond), 10.vi.39, *ESB* (HD).

Kent. Lee, *ES* (37) (4) (22); and beyond the boundary at Higham Marshes, 17.iv.57, *KCS* (14) (22).

Surrey. Wandsworth Common, n.d. [prior to 1833] in clay bottom of pond, *GS* (29); n.d. [prior to 1865], *D & S* (28) (36) (37) (3); Richmond Park, 18.xii.36, *JLHa* (*Jour. Wimbledon nat. Hist. Soc.* **5,** 24, 1937); (Pen Ponds), ix.34, adults and nymphs, *JED* (1/**1934-35,** 41); 1934-38, *EJP* (68b); Morden, *GWK* (3); Mitcham, 20.v.03, *WW* (60); Reigate, 28.ii.1868, Little Moat, n.c. (BM); Earlswood Common pond [prior to 1867] *J & TL* (32) (37) (3); Ranmore Common, 8.ix.35, *JLHa* (*Jour. Wimbledon nat. Hist. Soc.* **4** (1), 7, 1936); Epsom Common, n.d. [*circa* 1948] *AEG* (1/**1948-49,** 10); (Stew Ponds), 9.vii.50, *EWG* (24); 15.vi.52, *AEG* (1/**1952-53,** 31); Bookham Common, 4.iv.31, *FJC* (1/**1931-32,** 55); 13.ix.42, two specimens in Central Ditch, *JLHa* (82); Esher Common (Black Pond), 19.v.1900, *SWK* (1/**1900,** 9); 18.v.01, *SWK* (1/**1901,** 12); 13.vi.36, *JLHa* (*Jour. Wimbledon nat. Hist. Soc.* **4**(4), 26, 1936); Ockham Common, 7.vii.1900, *SWK* (1/**1900,** 16); 2.vii.26, *JEHR* (BM); and on the boundary at Byfleet, iv.1899, *WJL* in *WW* coll. (60); and beyond at Chobham, n.d., *WB* (37) (3); and Horsell, 23.v.31, *FJC* (SL).

NAUCORIDAE

A single representative of this world-wide family occurs in Britain, being also widespread throughout the London area.

Ilyocoris cimicoides (Linn.) Saucer bug Sp.470 p.365
D & S p.580 *(Naucoris cimicoides)* S p.325 *(N. cimicoides)*
B p.556 (Sp.430, *N. cimicoides*)

Common. This active bug is found in muddy ponds, ditches and small lakes usually at the bottom among decaying vegetation. Pairing takes place by the overwintering adults from February onwards and the eggs are laid at the end of April. The majority of larvae have reached maturity by the end of August. The saucer bug feeds on both small crustaceans *(Asellus, Gammarus* and *Cladocera)* and the larvae of various aquatic insects. Care must be observed when picking up the adult in the hand as it is capable of sharply penetrating the skin with its rostrum.

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* This is probably the earliest historic record of a bug, other than the bed bug, from the LNHS area.

Middx. Hampstead Heath, 1949, in Viaduct Pond, *DL* (1/**1949-50,** 36-38) (EMM **85,** 253 & **86,** 130); Enfield (Wrotham Park), 19.v.53, 20.ix.53 & 11.x.53, in large cattle pond, *IFL* (71); 22.v.71, *BSN* (58); South Mimms (Mimms Wash Stream), 19.iv.53, 4.v.53 & 11.x.53, found under stones in the faster sections of the stream, *IFL* (71); (Dyrham Park), 18.i.53, 17.v.53, 20.ix.53 (adults and larvae) & 11.x.53, in overgrown ornamental pond, *IFL* (71); Stanmore, 25.iv.35, *EWC* (BM); and Hanwell, 11.iv.19, in first pond, n.c., (SL).

Herts. Barnet, 29.iii.50, *IFL* (BM); (Hadley Green), a large number of adults taken throughout the year 1953, during the months iii, iv, v, viii, ix, x, & xii, from all three ponds, *IFL* (71); 10.&17.iv.49 and 25.ix.53, *IFL* (BM); 30.x.70, in West pond, *BSN* (58); Monken Hadley (Hadley Common), 28.i.53, 22.ii.53, 9.&26.iii.53, 6.v.53, 25.ix.53 & 22.xi.53, in small circular pond on the Common, with much detritus and a clay bottom, *IFL* (71) (31); Totteridge, 4.vi.44, *CHA* (17); in two pools (one with much less mud) by roadside at Totteridge, 19.ix.37, *GAW* (67b); Colney Heath, 30.x.70, in shallow part of River Colne, *BSN* (58); Cheshunt, frequently met with in marsh dykes and ditches before 1957 and doubtless still to be found, *AAA* (51); (Hookes Marsh S. gravel pit), 18.viii.71, larvae fairly common in *Eleocharis* and green spindle algae, *BSN* (58); (Old River Lea), 18.viii.71, larva in slow river, *BSN* (58); Rye Meads, 22.viii.71, pool N.E. of Stanstead Abbots gravel pit, with abundance of *Juncus* and grass, common, *BSN* (58); Broxbourne Meads, 10.v.62, in gravel pit, *BSN* (58); Maple Cross, 14.x.70, in old flooded gravel pit, locally common, *BSN* (58); Hoddesdon (Lodge Hollow), 27.iv.60, in gravel pit pool, *BSN* (58); (Barclay Park lake), 17.iv.62, *BSN* (58); Haileybury, pond near 'heath', 8.vi.38, *ESB* (HD); (Roundings Pond), 19.ii.39, 9.vi.40, 26.v.40, 30.vi.40 (larvae), 14.vii.40, 2.ix.40, adult ♂♂ & ♀♀, *ESB* (HD); pond in the college Master's garden, 12.v.38, *ESB* (HD); Hertford Heath (Roundings), 22.iv.72, in overgrown roadside pond, *BSN* (58); small woodland pond near Hertford Heath, 7.x.40, a single female, *ESB* (67a).

Essex. Epping, 15.iv.1892, *H. Heasler* in *EAN* coll. (C); (Lindsey Street), 25.ix.64, in village pond, *BSN* (58); Epping Forest, 24.iv.16, eggs, *EAB* (BM); 5.&25.iii.07, *EAB* (C); 11.x.47, *FDB* (SL); 23.iii.52, *IFL* (BM); (Chingford), 20.xii.12, *EAB* (BM); (High Beach pond), xi.16, *CN* (35a); (Loughton), 10.vi.11 (I instar larva), 10.ix.10 (adult) & 11.ix.11 (adult & larva), *EAB* (BM); (Wake Valley pond), n.d. [prior to 1923], *CN* (35a); 5.viii.40 (3 larvae) & 3.ix.40 (a few larvae), *ESB* (67a); and beyond the boundary at Benfleet, 1.viii.61, *SL* (1/**1961,** 82); and South Benfleet, 23.x.60, *AEG* (1/**1960,** 31).

Kent. Plumstead Marshes, *WW* (4) (39) (22); Abbey Wood marshes, 15.x.58, found in dyke with thick vegetation, *AAA* (51); Lewisham, *WW* (4) (39) (22); Lee, *WW* (SL) (4) (39) (22); (Hither Green Lane), 24.iv.1897, 13.&16.x.1897 and 8.iv.1898, *WW* (60); Dartford Marshes, 5.x.52, in dyke, *IFL* (BM); on the boundary at Filbro' marshes, Gravesend, 5.iv.47, in ditch, *TRES* (13); and beyond at Higham Marshes, 27.ix.46, in dyke, *AMM* (70); 2.v.65, *AMM* (1/**1965,** 57).

Surrey. Richmond Park, 11.iii.17, pond near Ham Gate, n.c., (SL); (Pen Ponds), 1934-38, *EJP* (68b); Wimbledon Common, 22.iii.52, *LC* (64); (Scio Ponds) [prior to 1912], *WJ* (79); [circa 1937], *JLHa* (81); Southfields, *GWK* (3); Morden, *GWK* (3); Mitcham Common, 22.x.67, ten adult bugs seen within about 15 feet from the bank, pond floor covered with detritus, *G. Shephard* per *AAA* (51); Sanderstead [*circa* 1913], in Church Meadow pond, *TFC* (*Proc. Croydon nat. Hist. Sci. Soc.* **7,** cci, 1914); Reigate, ii.1868, *JAP* (BM); Earlswood Common ponds [prior to 1867], *J & TL* (32); *ES* (3); Boxhill, vi.36, *WEC* (BM); Epsom Common (Stew Ponds), 19.iv.39, 16.iv.50 & 12.iv.52, *EWG* (24); 29.iv.66, *BSN* (58); Chessington, 3.v.53, *L. W. Greenop* per *LC* (64); Bookham Common, 4.iv.31, *FJC* (SL) (1/**1931-32,** 55); 2.iv.38, in stagnant water, *FDB* in *FJC* coll. (SL); 12.xi.44, a single adult in IOW pond, *JLHa* (82); 29.vii.50, *DL* (1/**1950-51,** 76); 28.iv.51 in IOW pond, *DL* (34); 29.ix.51, n.c. (SL) (34); 31.iii.60, *DGH* (57); Esher Common (Black Pond), 19.v.1900, *SWK* (1/**1900,** 9); West End Common, 21.vii.52, beneath dried *Sphagnum* in dried up pond, abundant, *FJC* (62); Byfleet, ix.1880, *AJC* (HD); 4.v.47, in pond on the outskirts of the town, *SL* (1/**1947-48,** 60); and on the boundary at Wisley 21.x.68, in Boldermere, *BSN* (58); and beyond at Chobham, vi.1876, *ES* (HD) (3).

Bucks. Just over the boundary near Slough, 2.viii.33, in the Grand Junction Canal, *EJP* (67b).

APHELOCHEIRIDAE

Only a single representative of this family is found in Britain, it having been recorded from two out of the five counties that come within the LNHS area.

Aphelocheirus aestivalis (Fab.) Sp.471 p.366
(*A. montandoni* Horv.)
D & S p.578 S p.326 B. p.553 (Sp.429)

Rare. Found in rivers and streams that flow moderately and have gravelly or stony bottoms over which this bug moves sluggishly. Overwintered adults pair in late spring and eggs are laid from then until the end of summer. Larvae are abundant from August to mid-September, but by then they are usually outnumbered by the newly matured adults. This bug feeds mainly on the larvae of aquatic insects, e.g. Diptera (Chironomidae) and Ephemeroptera, but its front legs are not raptorial *(cf. Ilyocoris)*. Like the last species its 'bite' can be very painful if the bug is not handled carefully. Only the micropterous form is known to occur in Britain. Records for Essex, Kent, Surrey and Bucks. are required.

Middx. Uxbridge, 12.viii.32, adults common [*sic*] in weed masses caught on bridge pylons, *DCT* (33a); 21.ix.35, in gravel from bottom of swift flowing parts of the River Colne, *DCT* (33a) (RSM).

Herts. Hoddesdon, 6.viii.60, half-grown nymph taken in the River Lea, just below the weir, *CDR* (72).

NOTONECTIDAE

Four representatives of this world-wide family occur in Britain, all of which have been found in the London area. They are probably the most conspicuous of the water-bugs because of their manner of swimming 'on their backs' – hence their universal vernacular name of back-swimmers. All have a powerful rostrum capable of inflicting pain if mishandled. Their fore limbs are strongly raptorial and being strictly carnivorous they feed on almost any swimming animal up to the size of a small fish such as a minnow. They in turn occasionally fall prey to aquatic birds and there have been a number of instances where the remains of *Notonecta* have been identified in stomach contents (e.g. in mallard, shot in either St James's or Regent's Park, *fide* E. O. Höhn in *London Bird Report* **12,** 36-38, 1947, and B. S. Nau (pers. comm.) found the remains of two *Notonecta glauca* in a heron's pellet on Rye Meads, Herts., on 7.iv.69). Notonectids are strong fliers and freely migrate from pond to pond (Walton 67c, p.260) mostly at night. In the London area Johnson (79) (83) records that in October 1906, after a night of heavy rain and strong wind, he found six *Notonecta* in a temporary pool in an asphalt playground of a school in Bolingbroke Road,* Battersea. He suggests that they had most likely flown over from the meres on Wimbledon Common – a distance of more than three miles – since he knew of no other nearer ponds in which water-boatman were present in numbers. Notonectids in flight sometimes mistake reflective surfaces for water. R. C. L. Howitt (6/**9**, 21, 1950) records a dozen *Notonecta glauca* landing in daylight on the shining surface of the bonnet of his parked car.

Notonecta glauca Linn. Sp.472 p.368
D & S p.587 S p.329 B p.558 (Sp.431)

Abundant. Found in many small lakes, ponds (both natural and artificial), water-filled gravel pits, slow streams, ditches, canals and dykes. Walton (67c, p.248) believes the reason for its success in such a wide variety of aquatic habitats is due to its ability to tolerate a pH range of between 6-8.5, and may even be found in situations having a mild salinity. Overwintering adults pair mainly from the beginning of February to early May and the larvae hatched from the eggs take about two months to pass through the five instars. Most however have reached maturity by early August.

Middx. Buckingham Palace grounds, 1961, in lake, nymphs, *TRES* (52); Notting Hill, *JAP* (BM); Hampstead, 1884-88, *FAW* (23); Hampstead Heath, 11.vi.49 & 17.viii.49, in

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* Bolingbroke Walk is I think intended here by Johnson – E.W.G.

Viaduct Pond, very common, *DL* (SL) (1/**1949-50,** 36-38) (EMM **85,** 253); 21.iv.50, *DL* (HD) 22.iv.50 (♂♂ & ♀♀), *ESB* (HD); 23.v.50 & 26.vii.50 (♀), *DL* (SL); Finchley, 5.viii.46, *CHA* (17); South Mimms (Wrotham Park), 9.iv.53 (2♂♂, 1♀), *IFL* (BM) (71); 22.ii.53 (2♂♂, 2♀♀), 8.iii.53 (3♂♂, 6♀♀), 4.v.53 (4♀♀) & 22.xi.53 (1♀), all records of *IFL* (71); 22.v.71 & 21.iv.72, *BSN* (58); (Mimms Wash Stream) 29.iii.53 (1♂, 3♀♀), 3.iv.53 (1♂, 4♀♀), 8.v.53 (3♀♀), 19.v.53 (1♀), 20.ix.53 (9♂♂, 4♀♀), 11.x.53 (6♂♂, 2♀♀), 29.xi.53 (2♂♂, 1♀), 20.xii.53 (1♂, 1♀), all records of *IFL* (71); (Dyrham Park), many specimens taken on different dates from three ponds during 1953 in the months of i, iii, iv, v, ix, x, xi, & xii, *IFL* (71); 18.i.53 & 22.iii.53, *IFL* (BM); 30.x.70, in stream, frequent, *BSN* (58); Enfield (Beech Hill Park), 28.i.53 (2♀♀), 8.iii.53 (1♀), 25.viii.53 (5♂♂, 1♀), 29.x.53 (2♂♂, 4♀♀), 6.xii.53 (1♀); (Trent Park), 10.viii.71 a singleton in West Drive pond, locally common in E. lake and a single immature specimen in ornamental lily pond, *BSN* (58); Stanmore ponds, 14.x.70, common ('black marked form') in the acid ponds, *BSN* (58); Ruislip, v.47, *MEB* (BM); and Ruislip LNR, common in the Main and New Pool where it is not unusual to find larva instars both in spring and early summer e.g. II (v.64, *WFS*), and IV (24.vii.56, *EWG*) but by August the new adults are in the majority (49).

HERTS. Barnet, 26&27.i.53, 22.ii.53, 8.&26.iii.53, *IFL* (BM); (Hadley Green), 19.vii.49, 16.x.49, 9.iii.53 (Pond A), 26.iii.53 (Pond D), and 25.ix.53, *IFL* (BM); specimens taken on many dates in 1953 during the months of, i, ii, iii, iv, v, ix, x, xi, & xii, *IFL* (71); 30.x.70, West & Central ponds, *BSN* (58); 19.xii.71, frequent in SW Pond, *BSN* (58); 29.v.71, very common in EE Pond and common in SW Pond, *BSN* (58); 21.iv.72, a singleton in the weedy Brewery pond, *BSN* (58); Monken Hadley (Hadley Common), 28.i.53 (2♂♂, 1♀), 22.ii.53 (2♀♀), 9.iii.53 (1♂), 26.iii.53 (7♂♂, 5♀♀), 25.viii.53 (1♂, 1♀), 25.ix.53 (2♂♂, 1♀) and 22.ix.53 (1♂, 1♀), in small shallow pool with much detritus and clay bottom, pH 7-7.5, *IFL* (71) (31j); 30.x.70, frequent in both the lake and the pond, *BSN* (58); Rickmansworth, 15.vii.16, III & IV instar larvae, *EAB* (BM); (River Colne tributary stream), 14.x.70, two adults of the black marked form, *BSN* (58); West Hyde, 17.xii.71, in old cress beds, frequent, *BSN* (58); (River Colne), 14.x.70, *BSN* (58); Maple Cross, 14.x.70, at West Hyde Lodge, *BSN* (58); Colney Heath (River Colne), 30.x.70, in shallow part of river, frequent, *BSN* (58); 28.vii.71, a single adult in river head-stream, *BSN* (58); (Tyttenhanger Gravel Pit), 19.xii.71, frequent in rich gravel pit pool, *BSN* (58); (Smallford), 17.xii.71, fairly common in mature gravel pit, *BSN* (58); (Maple Cross Gravel Pit), 14.x.70 & 17.xii.71, common in old flooded gravel pit, *BSN* (58); River Colne/River Ver confluence, 1.x.71, *BSN* (58); Colney Street (River Ver), 1.x.71, two adults in vegetation at edge of shallow part of river, *BSN* (58); London Colney, 14.x.70, in the River Colne, common, *BSN* (58); St Albans, 15.xi.36, *PH* (BM); (Oaklands), 17.xii.71, in gravel pit pool, frequent, *BSN* (58); North Mimms (Brookman Park), 5.x.64, in Gobions pond, common, *BSN* (58); Cheshunt, 16.ix.59, two adults in the small River Lea, *AAA* (51); (Hookes Marsh), 22.x.70, in dyke, *BSN* (58); 18.viii.71, in gravel pit, *BSN* (58); Rye Meads, 8.xi.64, in effluent stream south of the railway, fairly common; (NL), 20.x.61, in ditch; (NL1), 7.v.60, in effluent lagoon; (NL/Meads), 26.iii.66 & 16.iii.68, in slow stream among algae-coated tree roots; (SL/Wks), 20.x.68, in slow stream; (Hut Pool), 18.viii.61 & 21.x.67, in stagnant pool; (N. Meadow Pond), 11.xii.71 & 18.iii.72, in deep rich pond; (Gravel Pit), 17.x.70 & 27.xii.71, in weedy pool, frequent; (Gravel Pit W. Pool), 25.iii.72 & 8.iv.72, in rich gravel pool; (Tottenham Stream, S. of main road), 17.x.70, in slow stream, fairly common; – all records *BSN* (58); Broxbournebury Gravel Pit, 18.x.70 & 21.iv.72, in small pools, *BSN* (58); in River Lea halfway between Hoddesdon and Rye House, 6.vii.40, a single adult, *ESB* (67a); Wormley (Beaumont Manor), 5.x.64, in field pond, common, *BSN* (58); Haileybury (Goldings Wood), 29.ix.38 & 9.x.38, *ESB* (HD); 7.x.40, 12 adults in artificial pond, *ESB* (67a); (Dell's Wood), 5.iv.40 & 9.vii.40, pond in the wood, *ESB* (HD); (Roundings Wood), 9.iv.40, pond on Roundings, ♂ & ♀ in cop., *ESB* (HD); brick pool in the College vegetable garden, 24.v.40, *ESB* (HD) (67a); pond in the College Master's garden, 11.v.38, *ESB* (HD); Hertingfordbury, 1 mile SW of Cole Green, 4.viii.40, in a series of pools interconnecting in sandy gravel pits, both on the NW and SE side of the Hertford-Hatfield road, *ESB* (67a); Brickenden Liberty (Ettridge Farm), 11.x.64 & 1.v.71, common in farm duck pond, *BSN* (58); (Swallow Grove Farm), 25.vii.70, in field pond, *BSN* (58); in stream near Hertford, 9.viii.40, in trickling water for the most part, *ESB* (67a); in a pond near Hertford Heath, 7.xi.38, *ESB* (HD); 5.iv.40 & 7.vii.40, partly overhung by trees, *ESB* (67a); and just beyond the boundary at Sarrat, N. of Rickmansworth, 10.ix.71, in village pond, common, *BSN* (58); Symondshyde, S.E. of Wheathampstead, 10.x.71, in rich pond, fairly common, *BSN* (58); Hertford (Bengeo Hall), 6.x.64, at the confluence of River Rib and River Lea, *BSN* (58); Ware (Old House, High Street), 12.xi.64, in garden pond, *BSN* (58); Waterford Gravel Pit, 29.x.64, in pit pools, *BSN* (58); and River Beame (Bullsmill), 29.x.64, in river, *BSN* (58).

Essex. Epping, 5.x.1895, *n.c.* (60); Epping Forest, n.d. [prior to 1923], common generally in ponds, *CN* (35a); 25.iii.07, *EAB* (C); 2.xi.12, *EAB* (BM); (Chingford), 7.v.39, *FDB* (SL); (Fairmead Bottom), in bomb crater ponds – Pond A, 19.vi.52 (1♂), 28.ix.52 (1♂, 3♀♀), – Pond B, 23.iii.52 (1♀), 28.ix.52 (2♀♀), – Pond C, 23.iii.52 (1♂), 10.iv.52 (1♀), 13.iv.52 (1♂, 1♀), 28.ix.52 (1♂, 4♀♀), – Pond D, 19.iv.52 (1♀), 28.ix.52 (2♂♂, 3♀♀) – all records *IFL* (33f); Pond C, 14.iv.52 & 3.ix.52, *IFL* (BM); (High Beach), 22.x.64, in pond, *BSN* (58); (Loughton), 22.x.64, in ponds, *BSN* (58); (Wake Valley Pond), 21.iv.64, *FB* (18); 5.viii.40 & 3.ix.40, *ESB* (67a), 27.vii.65, 2 adults and 1 nymph, *BSN* (58); (Wake), 10.ix.60, in bomb-crater pond, *FB* (18); just outside the W. border of Epping Forest, 5.viii.40, two or three adults from small pond about 10 yards across, *ESB* (67a); Waltham Abbey (Corn Hill Stream), 22.x.70, in dyke, frequent, *BSN* (58); Little Nazeing (Middle Street pond), 25.ix.64, six adults in field pond, *BSN* (58); Romford, ii.17, *n.c.* (SL); Stifford near Grays, 11.viii.79, *LJ* (71); and on the boundary at Harlow (Ealing Bridge), 16.x.64, in stream, *BSN* (58); (Parndon Hall lake), 19.x.62, several adults taken in shaded lake, *BSN* (58); and Harlow Common, 22.x.62, in clay pond, fairly common, *BSN* (58).

Kent. Blackheath, 12,viii.59 and 9.&13.xi.59, singly in garden pond at 63 Blackheath Park, *AAA* (51) (22); Plumstead Marsh, *WW* (4) (39) (22); Lewisham (Hilly Fields) [*circa* 1880], abundant in old disused brick ponds, *RA* (1/**1934-35**, 127); Lee, *WW* (4) (39) (22); Lee pit, *JAP* (BM); Lee (Hither Green Lane), 16.x.1897, pond in field, *WW* (60); Catford, *WW*, (4) (39) (22); Ruxley Gravel Pit, 17.iii.63, *KCS* (14); Dartford Marshes, 5.x.52, in dyke, *IFL* (BM); River Darent, 1963, between the head-spring and the tributary springs, below the ponds, *n.c.* (69); Keston, 11.ix.64, *PJC* (63); 12.iv.74, a pair collected by *A. & D. Smith* and given to *AAA* who reared them in a garden pond at 49 Montcalm Road, Charlton for two years but the introduction seems to have died out in 1976. – per *AAA* (51); and on the boundary at Gravesend, 26.x.49, *TRES* in *FJC* coll. (SL); Filbro' marshes, Gravesend, 5.iv.47, in ditches, *TRES* (13); and beyond at Higham Marshes, 7.xi.37, in dykes, *AMM* (70).

Surrey. Richmond Park, 19.ix.37, in pond with stream flowing through it, *GAW* (67b); in Leg of Mutton Pond, about ¼ mile W. of Robin Hood Gate, 27.viii.46, *EJP* (68b); Pen Ponds, 1934-38, *EJP* (68b); bomb crater pond between larger open pond and the road between Ham Gate and Richmond Gate, 27.viii.46, *EJP* (68b); Wimbledon Common [prior to 1912], common particularly in Jenny's Pond, *WJ* (79); (Scio Pond) [*c.* 1937], *JLHa* (81); 23.viii.46, in Kingsmere and in small stream draining from it towards Roehampton, *EJP* (68b); 23 & 24.viii.46, in several other smaller ponds by the Portsmouth Road and along the Putney-Wimbledon road, *EJP* (68b); Mitcham Common, 5.iv.52, *LC* (64); Godstone, 30.ix.71, in small pond in a field north of the A25, *KCS* (14); Reigate, *circa* 1950, muddy pool in May, *GBR* (45); Earlswood Common ponds [prior to 1867] *J & TL* (32); Burgh Heath, 18.vii.70, shallow sandy pond, frequent, *BSN* (58); Epsom Common, 11.vii.14, *n.c.* (*Proc. Croydon nat. Hist. sci. Soc.* **8**, xxii, 1915); 6.iv.66, in temporary grassy pond, *BSN* (58); (Stew Ponds), 26.iv.53, *EWG* (24); 29.iv.66 & 24.v.70, a single adult on each occasion, *BSN* (58); 19.iv.39 & 27.iv.40, in small pond S. of the culvert bank of southern Stew Pond [now inundated by large lake, see *antea*, footnote to p.262], *EWG* (24); Bookham Common, 4.iv.31, *FJC* (SL), 12.iv.53, *DGH* (57); 28.iv.51, in 1OW Pond, *DL* (34); 11.iv.54, in Stents Wood bomb crater, *EWG* (24); Esher Common, 17.ix.51, *HDS* (62); 1922-25, common in temporary pools colonized by *Juncus bulbosus*, *OWR* (61); (Black Pond), 19.v.1900, *SWK* (1/**1900**, 9); 18.v.01, nymph, *SWK* (1/**1901**, 12); 23.iii.31, *FJC* (1/**1931-32**, 49); 8.x.51, 29.x.51 & 6.v.52, *FJC* (SL); and on the boundary at Wisley, 7.vii.1894, in the Hut Pond [= Boldermere], very common, *HJT* (1/**1894**, 89); Byfleet, n.d., *n.c.* (SL); 4.v.47, in pond on outskirts of the town, *SL* (1/**1946-47**, 60); (Basingstoke Canal), 4.v.47, in neighbouring streams, *SL* (1/**1946-47**, 60); and beyond at Chobham, 4.x.36, *ECB* (NM); Horsell, 16.ix.31, *FJC* (SL); and in the Basingstoke Canal between Pirbright Bridge and Frimley Green, 1954-55, *HDS* (50).

Bucks. On the boundary at Stoke Poges, 2.viii.33, in a pond, *GAW* (67b); and beyond at Cholesbury (S. of Tring), 10.ix.71 & 10.xii.71, in village pond, *BSN* (58).

Notonecta obliqua Thunb. (*N. furcata* Fab.) Sp.473 p.370
B. p.559 (as *N. furcata* listed as a 'form' under Sp.431, *N. glauca*)

Occasional. The life cycle of this species is similar to that of the last. It is distinguished from *N. glauca* by having dark hemi-elytra with paler bands at the base of the corium and clavus (see p.37 of the key in Macan, T.T., *A Key to British Water Bugs*, Freshwater Biological Association Scientific Publication No.16, ed. 2, 1965, reprinted 1976). Brown (67, p.187), quoting Poisson, points out that *N.*

obliqua is very closely related to *N. glauca* and in the south of France both species interbreed. In the U.K. the two appear to be fairly well separated both physiologically and ecologically. There is however a variety ***delcourti*** (Macan, *op. cit.*) of which two records have so far been made in the London area (see below under records for Essex and Surrey). Bucks. records for *N. obliqua* are required.

Middx. Finchley, 5.viii.46, *CHA* (17); Epping Forest [prior to 1923], near the 'Robin Hood', *CN* (35a as var. *furcata*); Enfield (Trent Park), 10.viii.71, West Drive pond, *BSN* (58); South Mimms (Wrotham Park), 22.ii.53 (2♀♀), 8.iii.53 (3♀♀), 11.x.53 (1♀), and 22.xi.53 (1♂, 1♀), *IFL* (71); 21.iv.72, in rich open pond, *BSN* (58); Hendon, 14.ix.01, *ECB* (NM); and Greenford, 13.iv.12, *EAB* (BM).

Herts. Barnet, 27.i.53, *IFL* (BM); (Hadley Green), many specimens collected at various ponds on the Green in 1953 during the months of i-v and viii-xii, *IFL* (71); 16.vii.49, 5.ix.51, 22.ii.53 (Pond A), 26.iii.53 (Pond D), 26.iv.53 (Pond A), 6.v.53 (Pond A) and 25.ix.53, *IFL* (BM); 11.xi.51, *PNL* (BM); 30.x.70, from W. pond, E. pond and Central pond, and 29.v.71 & 19.xii.71 from S.W. Pond, *BNS* (58); Monken Hadley (Hadley Common), 28.i.53 (1♂), 9.iii.53 (1♀), 26.iii.53 (1♀), 25.viii.53 (1♀) and 25.ix.53 (2♂♂), *IFL* (71); 30.x.70, *BSN* (58); Radlett (Old Parkbury), 10.xii.64, gravel pit pool ♀, *BSN* (58); St Albans (Oaklands), 17.xii.71, gravel pit pool, frequent, *BSN* (58); Wormley Wood, 14.ix.41, *HWJ* (43); Haileybury (Golding Wood), 7.x.70, in artificially made pond, *ESB* (67a); 29.ix.38, 9.x.38, 2.ix.40 and 30.vi.40, *ESB* (HD); (Dell Wood), 9.vii.40, in pond, *ESB* (HD); (Roundings pond) 30.vi.40 & 14.vii.40, *ESB* (HD); Hertingfordbury, 4.viii.40, one mile S.W. of Cole Green, in pools either side of Hertford-Harlow road, *ESB* (67a); 7.ix.38, pond near Hertford, *ESB* (HD).

Essex. Epping Forest, 19.x.02, *ECB* (NM); 5.x.1895, *WJA* (SL); (Chingford), 2.xi.12 & 20.xii.12, *EAB* (BM); (Fairmead Bottom), in bomb crater A (28.ix.52, 2♂♂, 6♀♀), bomb crater B (23.iii.52, 1♀) (28.ix.52, 2♀♀), bomb crater C (28.ix.52, 1♂, 4♀♀) and bomb crater D (28.ix.52, 1♂, 2♀♀), *IFL* (33f); 15.iii.53, specimens from each of the four craters, *IFL* (BM); (Loughton), ix.1893, *n.c.* (BM); (Wake), 1.vi.61, in bomb crater pond, *FB* (16); (Wake Arms), 22.x.62, in very acid pond, a single adult, *BSN* (58); (Wake Valley pond), 21.iv.60, *FB* (18); and at Romford, 17.iii.17, *n.c.* (SL). The var. ***delcourti*** has been taken at Epping Forest, 19.x.02, *ECB* (NM).

Kent. Abbey Wood and Plumstead Marshes, 8.v.1897, *WW* (60); Lee (Hither Green Lane), 16.x.1897, pond in the field, *WW* (60); 16.v.1896, *WW* (SL); Catford (Ravensbourne River), 13.ix.01, *WW* (60); Foots Cray, 28.xii.52, *n.c.* (SL); Westerham, 28.iv.23, *PH* (BM); and on the boundary at Gravesend, 16.viii.08, *WW* (60); and Filbro' marshes, Gravesend, 20.ix.47, in ditch, *TRES* (13).

Surrey. Richmond Park, 3.x.25, *JEHR* in *J. Cowley* coll. (BM); pond with stream flowing through it, 19.ix.37, *GAW* (67b); (White Ash Pond), 6.i.52, *DJC & JABo* (BM); small pond 200 yards from NW shore of the Upper Pen Pond, 21.iii.54, *DL* (SL) (31i); Putney Heath, 24.viii.46, in small open ditch 20 yards from the end of Putney Heath road, *EJP* (68b); Wim. Comm. [presumably Wimbledon Common], n.d., *ES* (HD); 22.iii.52, *LC* (64); Burgh Heath, 12.iv.52, *LC* (64); Epsom Common (Stew Pond), 18.iv.52, *LC* (64); Bookham Common, 28.iv.51, in IOW pond, *DL* (SL) (34); 29.ix.51, *DL* (54); 31.iii.60, *DGH* (57); Oxshott Heath, 19.ii.05, *ECB* (NM); Esher Common, 17.ix.51, *HDS* (62); 15. & 23.x.51, ponds by the Black Pond, *FJC* (62) (SL); (Black Pond), 23.iii.31, *FJC* (SL) (1/**1931-2**, 49); on the boundary at Wisley, 7.vii.1894, in Hut Pond [= Boldermere], very common, *HJT* (1/**1894**, 88); Byfleet, 8.vii.50, in bomb crater pond near Basingstoke Canal *DL* (1/**1950-51**, 73); Wotton Hatch, near Dorking, 18.iv.36, *WEC* (BM); Horsell, 26.iii 32, *FJC* (SL); and in the Basingstoke Canal between Pirbright Bridge and Frimley Green, 1954-55, *HDS* (50). The var. ***delcourti*** has been taken in Richmond Park, 8.iv.55, near Ham Gate, *AMM* (70).

Notonecta viridis Delc. Sp.474 p.370
(as *N. marmorea* subsp. *viridis*)
B p.559 (under sp.431 as *N. halophila* Edw.)

Common. The hemi-elytra have dark markings along the anterior margin of the corium and the base of the membrane only, unlike *maculata* which is mottled over most of the hemi-elytra. The life history of *N. viridis* is similar to that of *glauca*. Bucks. records required.

MIDDX. Enfield (Beech Hill Park lake) 25.ix.53 (1♂), *IFL* (71) (BM); (Trent Park), 10.viii.71, in E. lake, *BSN* (58); South Mimms (Mimms Wash Stream), 20.ix.53 (1♂), 11.x.53 (1♀) and 29.xi.53 (1♀), *IFL* (71); 8.v.53, *IFL* (BM); (Dyrham Park), 20.ix.53 (1♂) & 29.xi.53 (1♂, 1♀), *IFL* (71); (Wrotham Park), 11.x.53 (1♂) & 22.xi.53 (1♀), *IFL* (71); and Stanmore, 26.iv.53, *PNL* (BM).

HERTS. Barnet, 22.&27.i.53, *IFL* (BM); (Hadley Green), 1953, many examples of both sexes in ponds on the Green during the months ii-v and viii-xii, *IFL* (71); 10.iv.49, 16.x.49, 29.iii.50, 5.ix.51, *DJC* (BM); 30.x.70, in W. pond, *BSN* (58); 21.iv.72, in weed in Brewery pond, *BSN* (58); Monken Hadley, 25.xi.51, *DJC* (BM); (Hadley Common), 22.ii.53 (1♂, 1♀), *IFL* (71); Elstree (Aldenham Reservoir), 29.i.53, *IFL* (BM); Broad Colney, 21.i.51, *IFL* (BM); St Albans (Oaklands), 17.xii.71, in gravel pit pool, *BSN* (58); Cheshunt (Hookes Marsh), 18.viii.71, in gravel pit pool, *BSN* (58); (Old River Lea), 18.viii.71, in very rich, slow river, *BSN* (58); Rye Meads, 28.x.61, in cattle trough in the Meads, *BSN* (58); 11.x.64, in peat pool, *BSN* (58); 11.x.64 & 19.x.70, in deep weedy pool of gravel pit, *BSN* (58); 11.x.70, in newly flooded gravel pit, *BSN* (58); 25.iii.72, in gravel pit, W. pool, *BSN* (58); Broxbourne Meads gravel pit, 10.v.62, *BSN* (58); Broxbourne (Lee Navigation), 1.v.62, in canal, *BSN* (58); Broxbournebury Gravel Pit, 18.x.70 & 24.iv.72, in small pools, *BSN* (58); Haileybury (Goldings Wood), 9.x.38, *ESB* (HD); Hertingfordbury, 4.viii.40, pool in gravel pits near Cole Green, *ESB* (HD) (67a); 7.xi.38, pond near Hertford, *ESB* (HD); and just beyond the boundary at Symonshyde, S.E. of Wheathampstead, 10.x.71, in rich pond, *BSN* (58).

ESSEX. Stifford near Grays, 11.viii.79, *LJ* (77); and just beyond the boundary at Benfleet, 26.vii.53, *AEG* (MM*).

KENT. Blackheath, 6.ix.59 & 6.x.59, in garden pond at 63 Blackheath Park, *AAA* (51) (22); (The Round Pond), 6.ix.81, (two half-grown nymphs), 16.x.81 (several adults together in same part of the pond, and 11.vi.82 (many small nymphs), *AAA* (51); Pulmstead Marshes, 20.ix.55, *RGR* (WBM); Abbey Wood Marshes, 16.iv.55, *KCS* (14); Ruxley Gravel Pit, 15.xii.62, *KCS* (14) (22); Dartford Marshes, 5.x.52, in dyke, *IFL* (BM); and on the boundary at Sevenoaks, 7.xi.62, *GEW* (BM); Gravesend Marshes, n.d., *ECB* (22); and beyond at Higham Marshes, 2.v.65, *AMM* (1/**1965,** 57) (22); saltings, 22.ii.28, in brackish water, *T. Esaki* (BM).

SURREY. Richmond Park, 1934-35, Pen Ponds, *EJP* (68b); in small pond 200 yards from the NW shore of the Upper Pen Pond, 21.iii.54, *DL* (31i); 19.ix.37, pond with stream flowing through it, *GAW* (67b); (White Ash Pond), 6.i.52, *DJC & JABo* (BM); Wimbledon Common, 23.viii.46, in small stream draining Kingsmere towards Roehampton, *EJP* (68b); 23.&24.viii.46, in several small ponds on the Common, *EJP* (68b); 24.ix.1898, *GWK* (BM); 11.xi.51, 16.xii.51 & 2.ii.52, *DJC & JABo* (BM); Headley, 1.vii.74, in the top pond in Nower Wood, *RRF* (66); Epsom Common (Stew Pond), 6.vii.75, *RRF* (66); Esher Common, 1922-25, in deep temporary pools colonized by *Juncus bulbosus*, *OWR* (61) (EMM, **62,** 267, 1926) (Black Pond), 23.iii.31, *FJC* (SL) (1/**1931-32,** 49, recorded therein as *N. glauca* but later corrected by *FJC* in (62)); and beyond the boundary at Chobham, 16.vi.74, in deep pool on Coxhill Green, *RRF* (66).

Notonecta maculata Fab. Sp.475 p.371
D & S p.588 S p.329 (as *N. glauca* var. *maculata*)
B p.559 (*sub* Sp.431)

Occasional. Usually found in aquatic habitats with a hard substrate (e.g. in concrete, stone or brick-walled reservoirs, tanks and ornamental garden ponds, etc.). The adults pair in the late summer and the eggs are laid from the end of August to mid-October. The female attaches its eggs to the hard substrate of the habitat instead of to water weeds as do the other notonectids. The eggs overwinter and hatch at the end of March or early April, the larvae reaching maturity in late July and early August. *N. maculata* is a voracious carnivore feeding on many aquatic animals occupying the same habitat, along with any insects that by chance fall into the water (e.g. flies, including daddy-long-legs, beetles and wasps). Bucks. records required.

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* Heteroptera seen by me in Maidstone Museum, Kent (i.e. material of L. C. Bushby, T. R. Eagles, A. E. Gardner, D. Leston, etc.) have been included in this paper although all the specimens, including other orders in the insect collection there, were destroyed in a serious fire in 1977. The Museum has since acquired the Heteroptera of the late K. C. Side and a record of those of his specimens in the Natural History Department will now be noted.

Middx. Bedford Row, W.C.1, 28.viii.23, at light, *Trenwith Wills,* (BM); Hampstead Heath, 25.v.50 & 3.viii.50, in Viaduct Pond, *DL* (SL) (EMM **85**, 253); Finchley, 12.iii.44, *CHA* (17); Stanmore, 25.x.53, *PNL* (BM).

Herts. Barnet (Hadley Green), 19.vii.49, *IFL* (BM); 25.viii.53, (1♀) & 29.x.53 (1♀), in small circular pond, *IFL* (71); 29.v.71, in EE Pond, *BSN* (58); 21.iv.72, in Round Pond, *BSN* (58); Chorley Wood, 28.viii.60, *A.A.A. Disney* (BM); St Stephen (Ambassador College), 1.x.71, in galvanized trough, *BSN* (58); (Radlett (Old Parkbury), 10.xii.64, in small pool, *BSN* (58); St Albans, 17.xii.71, in gravel pit pool, *BSN* (58); Rye Meads, 16.iii.68, NL/Meads, a singleton in slow stream among algae-coated tree roots, *BSN* (58); in East Gravel pit, 11.x.70, *BSN* (58); Broxbournebury, 18.x.70, in gravel pit pools, *BSN* (58); Broxbourne (Baas Lane), 6.vii.61, in clay pond in garden, *BSN* (58); Broxbourne Woods (Pembridge Lane), 12.xi.61, in field pond, *BSN* (58); Haileybury (Goldings Wood), 9.&12.x.38, in pond, *ESB* (HD); 24.v.40, pond in College vegetable garden, *ESB* (HD); 19.ix.39 & 9.iv.40, in sunken brick pool in College garden, *ESB* (HD) (67a); 21.iv.40, 24.v.40, 11.vii.40, 7.viii.40 & 3.xi.40, *ESB* (67a); Bayford Station, 11.x.64 in trough, *BSN* (58); and just beyond the boundary at Boxmoor, 26.ix.46, in rapid flight near some old converted stables, *BV* (EMM **85,** 249-253).

Essex. Epping, 5.x.1895, *n.c.* (60); just outside the W. border of Epping Forest, 5.viii.40, a single adult in a small pool about 10 yards across, *ESB* (67a); and at Lower Nazeing (Middle Street Pond), 25.ix.64, a singleton from field pond, *BSN* (58).

Kent. Deptford, xi.49, *n.c.* (BM); Blackheath, 18.viii.59, 7.&11.ix.59, 27.ix.59, and 6.x.59, in garden pond at 63 Blackheath Park, *AAA* (51) (22); Darenth Wood, 13.viii.05, in the pond, *WW* (60); Bromley, 11.ix.64, *PJC* (63); and on the boundary at Gravesend, 1947, *TRES* in *FJC* coll. (SL).

Surrey. Richmond Park, 1934-38, Pen Ponds, *EJP* (68b); 27.viii.46, in open pond near Sheen Gate, *EJP* (68b); Putney Heath, 24.viii.46, in a small horse pond near the Putney-Wimbledon road and about ¼ mile from Tibbets Corner, *EJP* (68b); Wimbledon Common, 23.viii.46, in a small pond 200 yards W. of Kingsmere on the S. side of the Portsmouth road, *EJP* (68b); Norwood, n.d. *n.c.* (RSM); Reigate, *circa* 1950, in horse-trough in August, *GBR* (45); Burgh Heath, 18.vii.70, in shallow sandy pond, *BSN* (58); Bookham Common, 15.viii.53, *LC* (64); 18.iv.42 & 4.viii.53, *FJC* (SL); Oxshott, 19.ii.05, *ECB* (NM); 18.vii.53, *HDS* (62); Esher Common, 1922-25, common in deep temporary pools colonized by *Juncus bulbosus, OWR* (61); 17.ix.52, *HDS* (62); 18.vii.53, in pond on the heath, *FJC* (1/**1953-54,** 85-86); (Black Pond), 8.x.51 & 15.x.51, *FJC* (SL) (62); and on the boundary at Westcott near Dorking, 25.x.35, *WEC* (BM); and Byfleet, 8.vii.50, in bomb-crater pond near Basingstoke Canal, *DL* (1/**1950-51,** 73); and beyond the boundary at Woking, *JAP* (BM); and in the Basingstoke Canal between Pirbright Bridge and Frimley, 1954-55, *HDS* (50).

PLEIDAE

There is only a single British representative of this small but world-wide family of lesser water boatmen and this has been recorded from all the counties that fall within the LNHS area.

Plea atomaria (Pallas) Lesser waterboatman Sp.467 p.372
(*P. leachii* MacGregor)
D & S p.591 (*P. minutissima*) S p.330 (*P. minutissima*)
B p.563 (p.432 *P. minutissima*)

Common, sometimes locally abundant. This small bug occurs in ponds (often where there is plenty of detritus) and in small lakes, streams and sluggish rivers where the underwater weeds (e.g. *Ranunculus aquatilis, Myriophyllum* spp. or *Ceratophyllum demersum*) are plentiful. Mating does not occur in the adult until late June and July and the eggs which are laid then take about a month to hatch. The larvae require a further 6-8 weeks before they reach maturity in September. They feed on water-fleas, often congregating in numbers whenever the food supply is abundant.

Middx. Hampstead Heath, 1949, in Viaduct Pond, sparingly, *DL* (1/**1949-50,** 36-38); 27.v.50, very common, *DL* (SL) (EMM **85,** 253 & **86,** 130); South Mimms (Wrotham Park), 20.ix.53, adults abundant, *IFL* (71); Stanmore, 25.iv.35, *EWC* (BM).

HERTS. Barnet (Hadley Green), 26.iii.53, in Pond D, *IFL* (BM); 21.iv.72 in SW pond, an open weedy pool, *BSN* (58); Monken Hadley (Hadley Common), 26.iii.53 (24 adults), 25.viii.53 (1 nymph) & 25.ix.53 (11 adults), *IFL* (71); 1953, common in small shallow pond with much detritus and a clay bottom, *IFL* (31j); Totteridge, 19.ix.37, in pool by the roadside, *GAW* (67b); Haileybury (Roundings Pond), 14.ii.39, 28.viii.39 and 10.&26.iii.40, *ESB* (HD); Hertingfordbury, 4.viii.40, a single nymph in pool in gravel pits near Cole Green, *ESB* (67a).

ESSEX. Epping Forest, 21.iv.01, *ECB* (NM); (Wake Valley Pond), n.d. [prior to 1923], *CN* (35a); (Goldings Hill pond), 2.vii.40 & 3.vi.49, *ESB* (HD); (Loughton), ix.1893, *EAB* (Bm); (Fairmead Bottom), 19.iv.52 (1♂), in bomb-crater pond A, lined with dead leaves in places, pH 7.0, *IFL* (BM); (33f).

KENT. Blackheath, n.d., *WW* (1/**1899**, 80); Lee (Hither Green Lane),6.iv.1899, pond in field, *WW* (60) (39); Catford, n.d., *WW* (39); and on the boundary at Gravesend, 6.iii.38, *ECB* (NM); Filbro' Marshes, Gravesend, ix.47, *TRES* (13); and beyond at Higham Marshes, 2.v.65, *AMM* (1/**1965**, 57); 27.viii.60, *KCS* (14) (22).

SURREY. Richmond Park, 19.ix.37, in pond with stream flowing through it, *GAW* (67b); Wimbledon Common, 24.viii.46, in a large closed pond near the Putney-Wimbledon road, situated ½ mile from the Wimbledon end of Wimbledon Common, *EJP* (68b); 23.vii.46, in open pond on S. side of the Portsmouth Road [=Jerry's Pond], about ½ mile SE of Roehampton, *EJP* (68b); (Scio Pond), [*circa* 1937], *JLHa* (81); 1945 very abundant, *AWJ* (19); Godstone, 21.ix.71, small pond in a field north of the A25, *KCS* (14); Boxhill, 25.vii.52, *DL* (SL); Bookham Common, 4.iv.31, *FJC* (SL) (1/**1931-32,** 55); 28.iv.51 & 29.ix.51, in IOW pond, *DL* (34); 14.viii.60, *DL* (HD); 12.iii.61, *EWG & A. Eve* (24); Esher Common (Black Pond), 19.v.1900, *SWK* (1/**1900,** 9); and on the boundary at Effingham, 18.iv.31, *FJC* (1/**1931-32,** 55); Byfleet (Basingstoke Canal), 8.viii.50, abundant in Canal, *DL* (1/**1950-51,** 73); and beyond near Chobham, 24.ix.37, in pool in small wood much shaded by trees and with many dead leaves, *GAW* (67b); Woking, v.1888, *ES* (HD); *JAP* (BM); and in the Basingstoke Canal between Pirbright Bridge and Frimley Green, 1954-55, *HDS* (50).

BUCKS. Slough, iii.66, *GEW* (BM); (PILG), iv.66, in fish tank, *GEW* (BM).

CORIXIDAE

Of all the water bugs throughout the world the Corixidae are probably the most successful. Unlike other families in the Hydrocorisae which are carnivorous, some members of the Corixidae are predacious or have a mixed diet, but many others are entirely vegetarian, feeding on algae found on the bottom. During the first two larval stages all corixids breathe by diffusion of the oxygen dissolved in the water, but at the onset of the third instar a major change occurs with the spiracles opening and the whole body becoming more buoyant. For the remaining instars and throughout adult life corixids come to the surface for renewal of air, trapping a supply beneath their wing cases. This air-store acts as a 'physical gill' enabling a corixid to remain under water for a considerable time before a refill at the surface is necessary. Twenty-eight species of this family have been recorded positively for the London area and one further species, namely *Arctocorisa carinata,* where there is some doubt.

Micronecta scholtzi (Fieb.) Sp.477 p.373
S p.343 (*Sigara scholtzi*) B p.602 (Sp.462, *M. meridionalis*)

Very local though sometimes abundant where it occurs. Found in large ponds, lakes, canals and rivers that have parts where the water is shallow, weed free and have a gravelly bottom. This species overwinters in the second or third larval instar, not reaching maturity to breed until the following June. These pair and in the warmer conditions of early summer the eggs quickly hatch into larvae which themselves soon become adult by August. It is the larvae of this second generation which overwinter. Brachypterous specimens are the form most often found. Bucks. records required.

MIDDX. Buckingham Palace grounds, 1961, abundant in the lake, *TRES* (52) (1/**1963,** 108); Hampstead, iv.03, *EAB* (BM); Enfield (Beech Hill Park lake), 25.viii.53, (1♀), 25.ix.53 (1♂), 29.x.53 (1 nymph) and 20.iv.54 (5♂♂, 3♀♀ & 1 nymph), *IFL* (71); South Mimms (Wrotham Park), [*circa* 1953-56), abundant in large lake, *IFL* (74).

HERTS. Barnet (Hadley Woods), [*circa* 1953-56], in small lake, in small numbers, *IFL* (74); Elstree, 8.vii.65, *CHA* (17); Rickmansworth (Stocker's Lake), 15.viii.53, in gravel pit, *PNL* (BM); Broxbourne (River Lea), 3.viii.49 (♀), vi.49 (♀), and 30.viii.49, *ESB* (HD); and St Margarets, 2.vii.50, in the River Lea, *ESB* (HD).

ESSEX. Epping Forest (Loughton), x.01, *EAB* (BM); (Wake Valley Pond), 5.viii.40, *ESB* (HD) (67a); 5.vi.48 (♂♂ & ♀♀), *ESB* (HD); x.01, *CN* (35a).

KENT. Just beyond the boundary at Leybourne, 30.vii.63, *KCS* (14).

SURREY. Burgh Heath, 18.vii.70, by public house, in shallow sandy pond, abundant, *BSN* (58); Bookham Common, 1968-73, abundant in IOW Pond and Lower Eastern Pond each year during this period, *AELeG* (2/**52**, 77, 1973); and beyond the boundary at Chobham, vi.1876, *ES* (BM) (HD) (37) (3).

Micronecta poweri (D & S) Water singer Sp.478 p.374

Very local. Large ponds, lakes and rivers with shallows where the flow is slowed and the bottom sandy or muddy are the habitats for this species. It feeds on algal detritus and animal remains on the bottom. There are two generations a year of this species in southern Britain. The overwintering third instar larvae reach adult stage from May to mid-June and then pair directly. Eggs laid by the female and attached to stems and leaves of aquatic plants, soon hatch and pass rapidly through the larval instars to become adults by August. These mate in early autumn and it is the larvae of this generation that overwinter. This species gets its vernacular name from the ability of the males to stridulate very loudly. Middlesex, Essex and Bucks. records required.

HERTS. Broxbourne, 5.vi.59, 3.vii.49, 4.v.50 (3♀♀) and 18.vi.50 (♂ & ♀), in River Lea, *ESB* (HD); half way between Hoddesdon & Rye House, 6.viii.40, in the River Lea, *ESB* (67a) (HD); in the River Lea, 1 mile SW of Hertford, 4.viii.40, 22 adults & 2 nymphs, *ESB* (67a) (HD); and just over the boundary between St Albans and Redbourn, 18.viii.71, in the River Ver at Shafford Farm, locally common in clay shallows with *M. scholtzii, BSN* (58).

KENT. Lee (Burnt Ash Lane), 20.iv.1900, pond near Grove Park, *WW* (SL); Darenth, 16.vi.63, *GEW* (BM); Horton Kirby, 23.vi.62, near Farningham Road Station, in the River Darent, *WRD* (1/**1963**, 11) (22); 1963, at same locality, amongst waterweed in part of stream with muddy bottom, *AMM* (1/**1963**, 11) (22).

SURREY. Wallington *JAP* (BM) (see remarks in Walton (67d, pp.259 & 262 regarding this specimen); Walton-on-the-Hill, 18.vii.70, in shallow gravelly roadside pond, abundant, *BSN* (58); Esher, 27.vi.72, in Claremont Lake, *RRF* (66); and on the boundary at Chobham, vi.1876, *ES* (BM) (HD) (36) (37) (3) [recorded under *M. minutissima* in these last three sources but should be *poweri*, see Brown & Scudder (33g)]; and beyond at Ockley, 25.viii.71, in Vann Lake, *RRF* (66); and Cranleigh, 13.ii.73, in pond at junction of Horseshoe Lane and Common Road, *RRF* (66).

Micronecta minutissima (Linn.) Sp.479 p.375
D & S p.616 (*Sigara minutissima*)
S p.342 (*S. minutissima*)
B p.601 (Sp.461)

Rare. In the light of the examination by Brown & Scudder (33g) of the present position of this species vis-à-vis *scholtzi* and *poweri*, there remains only two records for *minutissima* in the London area (see below) of those made in Britain that these workers authenticated. All previous published records, including the Chobham, Surrey records, should be referred to *poweri* (*q.v.*). No further records of *minutissima* for London have come to hand. Its life history is probably similar to that of the previous species.

HERTS. Cheshunt, 5.vi.49, 3♂♂ taken in a semi-stagnant lake (pH 7.8) in an old gravel pit a short distance to the SE of the railway station, *ESB* (33g); 3.viii.49, ♂♂, *ESB* (HD); Broxbourne, 5.vi.49 (6♂♂, 20♀♀). 3.viii.49 (abundant) & 30.viii.49 (5♂♂, 3♀♀), in shallow water in River Lea one mile S. of the railway station, *ESB* (33g) (HD); 18.vi.50 ♂♂ & ♀♀, *ESB* (HD).

Cymatia coleoptrata (Fab.) Sp.480 p.376
D & S p.614 S p.342 (*Corixa coleoptrata*)
B p.600 (Sp.460, *C. coleoptrata*)

Local but sometimes abundant where it occurs. Found in ditches and ponds which have a slow flow of water passing over weeds interspersed with open areas. The adults pair in mid-June and the eggs are laid over a period of the next month. Adults from this generation are mature by the end of July. The next generation reach maturity by the end of autumn and it is these adults that will overwinter. The food of *C. coleoptrata* consists of chironomid and mayfly larvae, water fleas and other corixid larvae. It is the brachypterous form that is the more usual. Bucks. records required.

Middx. Hampstead Heath, n.d., *DL* (EMM **85**, 253 & **86**, 130); South Mimms (Dyrham Park), 18.i.53 (3♂♂, 1♀), 25.i.53 (2♂♂, 2♀♀), 22.iii.53 (3♂♂, 2♀♀), 19.iv.53 (11♂♂, 16♀♀), 10.v.53♂, 17.v.53 (4♂♂, 4♀♀), 20.ix.53 (14♂♂, 8♀♀), 11.x.53 (8♂♂, 3♀♀), 29.xi.53 (16♂♂, 15♀♀) & 13.xii.53 (1♂, 2♀♀) – all records *IFL* (71); 19.iv.53 (locality 2) & 18.i.53 (locality 11), *IFL* (BM); Stanmore, 26.viii.51, *IFL* (BM); 28.ix.51, in Spring pond, *PNL* (BM); Ruislip Reservoir, 17.viii.32, *DCT* (33a); Ruislip LNR, 1963-64, adults occasionally take in the Front Pool, *WFS* (49).

Herts. Barnet (Hadley Green), 21.iv.72, in Brewery pond, fairly common in this weedy pond, *BSN* (58); Colney Heath (Smallford) 17.xii.71, common in mature gravel pit, *BSN* (58); (Maple Cross), 17.xii.71, common in mature gravel pit, *BSN* (58); Cheshunt (Cadmore Lane Gravel Pit), 22.x.70, *BSN* (58); Rye Meads (SL/Works), 20.x.68, single specimens at five sites in slow stream, *BSN* (58); (E. Gravel Pit), 11.x.70, very abundant in 5-10 cms. of water, in newly flooded gravel pit, with *Elodea* and *Potamogeton, BSN* (58); (Gravel Pit W. Pool), 25.iii.72 (common) & 8.iv.72 (abundant), *BSN* (58); (pool old/new Gravel pit) 27.xii.71, common, *BSN* (58); (pool NE of Stanstead Abbots gravel pit), 22.viii.71, very common among emergent *Juncus,* etc. in this rich gravel pit pool, *BSN* (58); Broxbourne Meads, 10.vi.62 (4♂♂, 7♀♀, with two ♀♀ having a red mite under the wing, one with two (one each side)), in gravel pit, *BSN* (58); Broxbourne, 10.iv.47, pool in gravel pit, ♂ & ♀♀, brachypterous, *ESB* (HD); Broxbournebury Gravel pit, 21.iv.72, in small gravel pit pool, common, *BSN* (58); Hoddesdon (Barclay Park), 17.iv.62, common in ornamental lake, *BSN* (58); and on the boundary in Gilston Park lake, NW of Harlow, 3.xii.49, brachypterous ♂ & ♀, *ESB* (HD).

Essex. Epping Forest, 15.iv.15, *EAB* (BM); 23.iii.52, *IFL* (BM); (Chingford), ix.12, 2.xi.12 & 20.xii.12, *EAB* (BM); (Loughton), x.01, *EAB* (BM); 22.x.64, in various ponds, very common, *BSN* (58); (Goldings Hill ponds), 2.vii.40 (20♀♀, 17♀♀), in the lower of the two ponds, *ESB* (67a) (HD); 31.v.47, brachypterous ♀♀, *ESB* (HD); ponds near the 'Robin Hood', n.d. [prior to 1923], abundant, *CN* (35a); 26.viii.51, *AMM* (70); (Wake Valley pond), n.d. [prior to 1923], *CN* (35a); and Nazeing, 7.iv.13, *CN* (35a).

Kent. Blackheath (Round Pond), 25.iv.80, a single specimen, *AAA* (51); Lee, *WW* (4) (39) (22); and on the boundary at Gravesend, *JAP* (BM); 11.iv.14 & 9.x.15, *ECB* (NM) (22); and beyond at Higham Marshes, 28.iii.38, in dykes, *AMM* (SL) (70); 21.iv.46 (in new salt marsh) & 28.ix.46 (in dykes), not common, *AMM* (70) (22); 21.iv.46, *GEW* (BM); 27.viii.60, *KCS* (14); and 2.v.65, *AMM* (1/**1965**, 57).

Surrey. Richmond Park, 27.viii.46, in small pond 200 yards from the NW shore of the Upper Pen Pond, *EJP* (68b); 27.viii.46, in large open pond situated on the S. side of the road from Ham Gate to Richmond Gate, *EJP* (68b); Wimbledon Common, 18.i.53, *DJC & JABo* (BM); in open road [=Jerry's Pond] on S. side of the Portsmouth Road, ½ mile SE of Roehampton, 23.viii.46, *EJP* (68b); Morden, *GWK* (3); Burgh Heath, 18.vii.70, in shallow sandy pond near public house, *BSN* (58); Epsom Common, 6.iv.66, in polluted duck pond, a single ♂, *BSN* (58); (Stew Ponds 14.ix.47, ♂♂ & ♀♀, brachypterous, *ESB* (HD); 29.iv.66, very abundant, *BSN* (58); 24.v.70, in both ponds (common in the larger; a single specimen in the smaller pond), *BSN* (58); 6.vii.75, *RRF* (66); and beyond the boundary at Brookwood, 4.vi.38, *FJC* (SL); and in the Basingstoke Canal between Pirbright Bridge and Frimley Green, 1954-55, *HDS* (50).

Cymatia bonsdorffi (Sahlb.) Sp.481 p.377
D & S p.613 S p.341 (*Corixa bonsdorffi*)
B p.599 (Sp.459, *C. bonsdorffi*)

Occasional, sometimes frequent. This species is found in rivers, canals, lakes and ponds. Although submerged or emergent weed may be a determining factor in its presence in certain habitats, this species can tolerate a wide pH range even to acids pools where the organic matter has reached an advanced state of decomposition. *C. bonsdorffi* overwinters in the adult stage with pairing taking place during the following May to June. Both macropters and brachypters are known although the latter is the more usual form. Records for Kent and Bucks. are required.

Middx. Hampstead Heath, n.d., in pond on the Heath, *DL* (EMM **85**, 253); Ponders End, 17.vi.42, in quarry pool, ♀, *ESB* (HD); and Stanmore, 25.iv.35, *EWC* (BM).

Herts. Barnet (Hadley Green), 6.v.53, in a moderately large pond (pH 4.5-7) in the shallow area on southern side with fine gravelly bottom with silty detritus and no submerged vegetation, *IFL* (71); 29.v.71 in EE pond, *BSN* (58); 30.x.70, in W. pond, locally common, *BSN* (58); 21.iv.72, in Brewery Pond (present) and in Round Pond (fairly common), *BSN* (58); Monken Hadley (Hadley Common), 6.v.53♀, in small shallow pond with much detritus and clay bottom, pH 7-7.5, *IFL* (71) (31j); Radlett, 25.ii.59 & 16.iii.59, in gravel pit (11♀♀, 9♀♀), *IFL* (33h); Rye Meads (SL 13), 2.iv.66, in lagoon, ♂, *BSN* (58); (E. Gravel Pit), 11.x.70, fairly common, *BSN* (58); (E. Gravel Pit pool), 11.x.70, a single adult, *BSN* (58); (Gravel Pit pool adjacent to Old Gravel Pit), 16.v.71, *BSN* (58); (North Meadow pond), 18.iii.72, in deep pool, *BSN* (58); (pool Rd/new Gravel Pit), 27.xii.71, rich gravel pit pool, *BSN* (58); (Gravel Pit, W. Pool), 25.iii.72 (a single adult) & 8.iv.72 (frequent), *BSN* (58); Broxbourne Meads, 10.v.62, in gravel pit, 2 pairs in cop., also 4♂♂ & 12♀♀ of which 2♂♂ & 3♀♀ had large red mite (one had two) attached on the left side in each case, *BSN* (58).

Essex. Epping Forest (Chingford), 20.xii.12 & 19.iv.13, *EAB* (BM); (Loughton), 10.ix.14, *EAB* (BM); 20.x.64, in two ponds, *BSN* (58); ponds near the 'Robin Hood', n.d. [prior to 1923], *CN* (35a); (Goldings Hill ponds), 2.vii.40, 2♂♂ & 1♀, in the lower of the two ponds, *ESB* (67a) (HD).

Surrey. Banstead, 21.vii.52, ♀, at MV light trap, *AEG* (76); Epsom Common (Stew Pond), 6.iv.66 (a single ♂), 29.iv.66 (frequent) & 24.v.70 (frequent) and 24.v.70 (fairly common), *BSN* (58); in a small pond beyond the Stew Pond, 29.iv.66 (frequent), *BSN* (58); Bookham Common, 4.iv.31, *FJC* (SL); Esher, 9.vi.1897, *GWK* (BM); (Black Pond), 23.iii.31, *FJC* (SL) (1/**1931-32,** 49), 8.x.53, *FJC* (SL); and beyond the boundary at Woking, *GCC* (BM) (37) (3); and in the Basingstoke Canal between Pirbright Bridge and Frimley Green, 1954-55, *HDS* (50).

Callicorixa praeusta (Fieb.) Sp.483 p.379

S p.339 (*Corixa praeusta, C. soldalis & C. boldi*)

B p.594 (Sp.452, *C. praeusta;* & Sp.451, *C. boldi*) and p.595 (Sp.453, *C. soldalis*)

Common. Found in ponds, small lakes and stagnant reaches of rivers where there is marginal emergent vegetation and a degree of organic matter present. Overwintering adults pair in April and May, the larvae from the eggs taking the next two months until July to reach maturity. A second generation from these adults appear at the end of September or October and it is these that survive the winter. This species is a strong flier, migrating when necessary, at dusk. Bucks. records required.

Middx. Buckingham Palace grounds, 1961, in lake, *TRES* (52) (1/**1963,** 108); Hampstead Heath, n.d., in pond on the Heath, *DL* (EMM **85**, 253); Enfield (Beech Hill Park lake), 28.i.53♂, *IFL* (71); South Mimms (Dyrham Park), 11.x.53 (1♂, 2♀♀), 22.iii.53 (1♂, 1♀), *IFL* (71); (Wrotham Park), 8.iii.53 (2♂♂) & 22.xi.53♂, *IFL* (71); Ruislip LNR, 1963-64, a common species in the Main pools but rarely found in the New Pool (2♀♀ only, 30.ix.64) *WFS* (49); near Greenford, v.02♂ & ♀ *EAN* (C); Hanwell, 7.iv.06, *AJC* (HD).

Herts. Whetstone, 15.iv.59, in MV light trap, *PHW* (BM); 24.vi.60♂ & ♀, 28.vi.60♀, 29.vi.60 (3♂♂, 24♀♀), 30.vi.60 (4♂♂, 14♀♀), 1.vii.60 (4♂♂, 4♀♀), 6.vii.60♀, 7.vii.60♀, and 9.vii.60♀, all taken at MV light trap and representing over 28% of the entire Heteroptera caught in the trap during 1960, *PHW* (pers. comm. & 47); Barnet (Hadley Green), 9.iii.53, in moderately large pond (pH 4.5-7) in shallow area on S. side where the bottom was gravelly with silting detritus and no submerged vegetation, ♂, and 29.x.53, in shallow area on N. side of same pond, 2♀♀ & 1♂, *IFL* (71); 25.ix.53 in large pond with bottom of coarse gravel and much detritus, ♂, *IFL* (71); in a small circular pond about 100 yards from the large pond, 22.ii.53♀, 6.v.53♂, 25.ix.53 (1♂, 2♀♀) and 22.xi.53 (2♂♂, 4♀♀), *IFL* (71); Monken Hadley (Hadley Common), 1953, in small shallow pond on the Common with much detritus and a clay bottom, pH 7-7.5, *IFL* (31j); Totteridge, 19.ix.37, in pool by roadside, *GAW* (67b); Elstree, 8.vii.45, *CHA* (17); Radlett, 25.ii.59 & 16.iii.59, in gravel pit, ♂ & ♀, *IFL* (33h); London Colney (Swallowford), 5.x.64, in the River Colne, ♀, *BSN* (58); Hatfield, 20.iii.59, *IFL* (EMM, **95**, 168) (33h); Cheshunt, 6.iv.12, *EAB* (BM) (11) (12); (in small River Lea), 16.ix.59, *AAA* (51); Rye Meads, 8.xi.64, effluent stream S. of railway, (NL/Meads), 16.iii.68, in slow stream among algal-covered tree roots; (NL 2), 27.ix.64, lagoon; (NL 4), 22.x.61, 27.ix.64 (lily pond) & 31.vii.65 (edge of sedges); (NL 5), 22.x.61, 7.xi.62 ♂ & ♀ (torpid in flotsam) & 31.vii.65 (in clear water); (NL 9), 21.x.67, 4♂♂ in lagoon; (SL 10/N. End), 19.iv.69, effluent lagoon, frequent, (SL 11), 2.iv.66, effluent lagoon, ♀; (SL 15), 4.x.64; (SL/wks), 20.x.68, slow stream; (E. Gravel Pool), 11.x.70; (SNL 8 & 9), 2.xi.68, effluent lagoon; (Small SL), 2.xi.68, fairly common; (N. Meadow Pond), 11.xii.71 & 18.iii.72, fairly common at edge of *Carex* along S. side of this deep pond; (River Stort); 8.xi.64; – all these records of *BSN* (58); between Rye Meads and Stanstead Abbots, 26.vi.65, in gravel pit, common, *BSN* (58); Lemsford Springs, 7.v.72, peat pool, *BSN* (58); Broxbourne Woods, 6.iv.40, in large woodland pond, fairly deep, ♂, *ESB* (67a) (HD); Broxbourne (Broad Riding Wood), 28.x.61, in pond, ♂, *BSN* (58) Potters Bar (Park Lake), 22.x.70, frequent in paddling pool containing leaves and a single specimen in ornamental lake, *BSN* (58); Hoddesdon (Barclay Park), 17.iv.62, in lake, ♀, *BSN* (58); Hoddesdon Gravel Pit, 19.vi.40♀, in pools, *ESB* (HD); Great Amwell, 27.iii.40, in closed shallow pond in orchard, *ESB* (HD); Haileybury, 11.v.46, pond in the College Master's garden, ♀, *ESB* (HD); (Rounding Pond), 30.vi.40♀, *ESB* (HD); Hertingfordbury in Gravel Pits near Cole Green, 4.viii.40, pools on NW side of the Hertford-Hatfield road, ♀, *ESB* (67a) (HD); Brickenden Liberty, 14.iv.62, 2♂♂, 1♀, in pond, *BSN* (58); Jenningsbury Moat, 1 mile SW of Hertford, 23.v.40♀, 16.vi.40 (♂♂ & ♀♀) & 3.viii.40♀, in 20 yard stretch of black mud devoid of vegetation, the remainder of the moat shaded by trees, *ESB* (HD) (67a); and just beyond the boundary at Wheathampstead, v-ix, 1959, taken in MV light trap sited in a small orchard of fruit trees, *IFL* (33h); River Beame (Bullsmill), 29.x.64, frequent, *BSN* (58); Waterford Gravel Pit, 29.x.64, *BSN* (58); Stansborough Lakes N., 1.xi.70, frequent in river-fed lake, *BSN* (58); Symondshyde, S.E. of Wheathampstead, 10.x.71, frequent in rich pond, *BSN* (58); and at Harpenden, in grounds of Rothamsted Expt. Station, a very large number to MV light trap (470♂♂, 458♀♀) taken during the period 1946-1950, *ESB* (84).

Essex. Epping Forest (Loughton), 22.x.64, in ponds, common, *BSN* (58); (Goldings Hill ponds), 2.vii.40, in the lower of the two ponds, 3♂♂, 1♀, *ESB* (67a) (HD); Epping Plain, 25.ix.64, in Tile Kiln ponds, ♀, *BSN* (58); Lindsey Street, 25.ix.64, in village pond, 3♂♂, 2♀♀, *BSN* (58); Epping Upland (Chambers Manor Farm), 25.ix.64, in cattle pond, 3♂♂, 3♀♀, *BSN* (58); Epping Green, 25.ix.64, in duck pond, ♂, *BSN* (58); Nazeing, 7.iv.13, *EAB* (NM); 7.iv.13, *CN* (35a); (Middle Street), 25.ix.64, pond by roadside, 2♂♂, *BSN* (58); Rye Hill (Rivetts Farm), 2 miles SW of Potter Street, 27.&30.x.64, in field pond, very common, *BSN* (58); Netteswell, 2½ miles SW of Harlow, 27.x.64, in lake, *BSN* (58); Potter Street, 3 miles S. of Harlow, 22.x.62, duck pond on clay, ♀, *BSN* (58).

Kent. Brockley, n.d. *WW* (39); Charlton, at intervals from June-July 1976 onwards, singly at MV light trap, *AAA* (51); Lee, *JAP* (BM); *JS* (BM); *GCC* (BM); (Hither Green Lane), 16.&30.x.1897 and 6.iv.1899, pond in field, *WW* (60) (4) (39) (22); in the ponds on Blackheath, various dates *circa* 1977 onwards, ♀♀ more common than ♂♂, *AAA* (51); in garden of 63 Blackheath Park, 20.viii.59, 15.ix.59 and 3.&19.x.59, singly on each date, *AAA* (51) (22); at MV light trap, occasional (e.g. vi.60 & 10.viii.69), *AAA* (51) (22); Abbey Wood Marshes, 15.x.58, two adults in weedy dyke, *AAA* (51) (22); and beyond the boundary at Higham Marshes, 28.ix.46, in dykes, local, *AAA* (70).

Surrey. Richmond Park, 21.iii.54, in open pond close to Ham Gate, 4♀♀, *DL* (31i); Wimbledon Common, 24.viii.46, in a large closed pond near Putney-Wimbledon road, situated ½ mile from Wimbledon end of the Common, *EJP* (68b); open pond on S. side of Portsmouth Road, ½ mile SE of Roehampton, 23.iii.54, 3♀♀, *DL* (31i); (Kingsmere), 23.iii.54, ♂, *DL* (31i); Banstead, many dates in the months of v, vii, & viii.52 and v, vii & viii.53, ♂♂ & ♀♀, common, in MV light trap, *AEG* (76 and EMM **90**, 166); 19.vii.52, *AEG* (MM); vii.52, *AEG* (1/**1952-53**, 12); Reigate, *ES* (36); Epsom Common (Stew Pond), 6.iv.66 (2 adults), 29.iv.66♂ and 24.v.70 (frequent), *BSN* (58); Bookham Common, 4.iv.31, *FJC* (SL); 15.viii.53, ♂♂ & ♀♀, *FJC* (SL); 31.iii.60, *DGH* (57); 14.viii.60, *DL* (HD); 26.v.63, *PLRJ* (20); 28.iv.51 & 29.ix.51, in IOW pond, *DL* (34); 11.iv.54, in IOW pond, *EWG* (24); Esher, *GCC* (BM); 9.&15.x.51, *FJC* (SL); Esher Common, 1922-25, in Black Pond and in temporary pools colonized by *Juncus bulbosus*, *OWR* (61); in small ponds near Black Pond, 23.iii.31, *FJC* (1/**1931-32,** 49) (SL).

Corixa punctata (Illig.) Sp.485 p.380
D & S p.593 (*C. geoffroyi*) S p.333 (*C. geoffroyi*)
B p.570 (Sp. 433, *C. geoffroyi*)

Common, sometimes abundant. The overwintering adults pair in January and February and eggs are laid between the end of January and the end of March. The five larval instars take 3-4 months to develop and adults are not seen in numbers until the end of July onwards. It is believed that this bug is vegetarian in its diet and like the last mentioned species it also migrates readily (*fide* Popham (68b, p.169)).

Middx. Hampstead Heath, 17.viii.49, Viaduct Pond, *DL* (C) (1/**1949-50,** 36-38) (EMM **85,** 253); Finchley, 28.vii.46, *CHA* (17); Enfield (Trent Park), 10.viii.71, frequent in the open, rich, W. Drive pond and common in the ornamental lily pond, *BSN* (58); South Mimms (Mimms Wash Stream), 29.iii.53 (3♀♀), 8.v.53 (4♀♀), 20.ix.53 (1♂, 1♀) and 11.x.53♂, *IFL* (71); (Dyrham Park), 18.i.53 (1♂, 2♀♀), 19.iv.53 (3♂♂, 2♀♀), 17.v.53 (3♂♂, 1♀) 20.ix.53 (2♀♀), 11.x.53♀, 29.xi.53♂ and 13.xii.53♀, in overgrown ornamental pond with gravelly bottom and patches of detritus, pH 6.5-7, *IFL* (71); 22.ii.53 (1♂, 5♀), 19.iv.53♀ & 29.xi.53 (2♂♂), in large pond, bottom covered with detritus twigs and small branches from overhanging trees, *IFL* (71); 22.iii.53♀ & 29.xi.53♀, in small circular pond close to the large pond [just mentioned] with bottom covered with dead leaves and surrounded by willows, pH 4.5-6, *IFL* (71); (Wrotham Park), 22.ii.53 (3♀♀), 8.iii.53♀, 13.v.53♀, 20.ix.53 (3♂♂, 6♀♀), 11.x.53 (9♂♂, 7♀♀), 22.xi.53 (1♂, 3♀♀) & 13.xii.53♂, in large cattle pond, gravelly bottom and thick layer of silty detritus, pH about 7, *IFL* (71); 20.iv.72, a single specimen in this rich pasture pond, *BSN* (58); Ruislip LNR, 1963-64, occasionally in the Front Pool but more frequently in the densely vegetated S. end of the New Pool in September (e.g. ix.64, *WFS*) though absent there in the following month (49).

Herts. Barnet (Hadley Green), in the moderately large pond with an island, pH 4.5-7, many ♂♂ & ♀♀ taken in 1953 during the months iii, v, and viii-xii, *IFL* (71); in a slightly larger pond [than the previous], 9.iii.53♀, 26.iii.53 (5♀♀) & 29.x.53 (2♀♀); and in a small circular pond about 100 yards from the large pond, 27.i.53 (2♂♂), 22.ii.53 (♂ & ♀), 25.ix.53 (2♂♂, 1♀), 29.x.53♀, 22.xi.53 (2♀♀) & 13.xii.53♀, *IFL* (71); 25.ix.53, *IFL* (BM); 30.x.70, in West Pond, frequent, *BSN* (58); Monken Hadley (pond on Hadley Common), 28.i.53 (1♂, 2♀♀), 22.ii.53 (5♂♂, 9♀♀), 9.iii.53 (2♂♂, 1♀), 26.iii.53 (2♂♂, 5♀♀), 25.viii.53♀, 25.ix.53 (8♂♂, 2♀♀), 22.xi.53 (9♂♂, 15♀♀) & 13.xii.53♂, very abundant *IFL* (71) (31j); 30.x.70, in weedy pond, frequent, *BSN* (58); Totteridge, 19.ix.37, in pools by the roadside, *GAW* (67b); 1 mile SW of Rickmansworth, 16.i.77, in small weedy pool fouled by sheep, *PAN* (78); Chorleywood Common, 10.ix.71, in overgrown ponds, *BSN* (78); Radlett gravel pit, 25.ii.59 & 16.iii.59, 13♀♀, *IFL* (33h); Broad Colney, 1.x.71, in shallow part of River Colne, *BSN* (58); London Colney, 25.ii.59♀, in pond near Gravel pit, *IFL* (33h); Colney Heath (Tyttenhanger Gravel Pit), 19.xii.71, fairly common in gravel pit pool, *BSN* (58); St Albans (Oaklands), 17.xii.71, fairly common in gravel pit pool, *BSN* (58); North Mimms (Water End), 5.x.64, two adults in draught pool of Mimmshall Brook, *BSN* (58); (Brookham Park), 5.x.64, in Gobions Pond, frequent, *BSN* (58); near Hatfield, 22.iii.59, ♂♂ & ♀♀ in five ponds, *IFL* (33h) (EMM **95,** 168); Essendon (Wildhill), 1.v.71, in shallow field pond, frequent, *BSN* (58); Cheshunt, 16.ix.59, in the small River Lea, *AAA* (51); Rye Meads, 20.x.62, ♂ & ♀ in *Callitriche* in sluggish stream; 11.x.64, common in pond adjacent to ditch; 26.vi.65, nymphs, common in gravel pit; 8.xi.64, fairly common in effluent stream S. of railway; (NL 7), 10.iv.66, a single adult in effluent lagoon; (NL 9), 19.vi.71, nymph in effluent lagoon; (SL E. Channel), 15.viii.71, in effluent channel by hut; (SL/Wks), 20.x.68, frequent to fairly common along edge of slow stream; (SNL 8 & 9), 2.xi.68; (Small SL), 2.xi.68, one in effluent lagoon; (Gravel Pit W. Pool), 25.iii.72; (East Gravel Pit pool), 11.x.70; (N. Meadow Pond), 11.xii.71, deep water, two adults; 18.iii.72, frequent; 31.vii.71, common in deep pool; (pool NE of Stanstead Abbots Gravel Pit), 22.viii.71, two adults in rich gravel pit pool – all records of *BSN* (58); small ponds in Broxbournebury Gravel Pit, 18.x.70, abundant in pool of opaque green water and frequent in pool with marginal vegetation only, *BSN* (58); Broxbourne (Broad Riding Wood), 28.x.61, 6♂♂, & ♀♀, in open pond in the SE corner of the wood, *BSN* (58); Hoddesdon (Lodge Hollow), 27.iv.60, 5.&7.60, and 11.vi.61, single specimens from pools in gravel workings, *BSN* (58); Haileybury, 11.v.38, 8.vii.38 & 9.viii.38, from pond in the College Master's garden, *ESB* (HD); (Roundings Pond), 9.iv.40, 30.vi.40, 14.vii.40, 2.ix.40 and 16.iii.41, *ESB* (HD); Golding's Wood pond near Hertford Heath, 7.x.40 (1♂, 2♀♀), in artificially made pond, *ESB* (67a); Brickenden Liberty, 14.iv.62 (1♂, 3♀♀), in pond *BSN* (58); (Monk's Green), 14.iv.62 (2♀♀) in pond, *BSN* (58); (Elbow Lane), 6.v.62 (2♂♂) in pond, *BSN* (58); (Ettridge Farm), 11.x.64, in cattle trough, two adults, *BSN* (58); pond by the Hertford-Hoddesdon road near Jenningsbury, 10.iv.40♀, *ESB* (67a); Jenningsbury Moat, about 1 mile S. of Hertford, 10.iv.40 & 3.viii.40 (3♂♂, 2♀♀) in part of the moat shaded by trees, *ESB* (67a) (HD); Hertingfordbury (pools in the gravel pits near Cole Green), 4.viii.40, 4♀♀ in pool NW side on the Hertford-Hatfield road, and 3♂♂ & 8♀♀ in pool on SE side of the same road, *ESB* (67a); pond near Hertford Heath, 4.v.41♀, partly overhung by trees, *ESB* (HD) (67a); and on the boundary at Sandridge, 25.ii.54 & 16.iii.54, (4♂♂, 9♀♀) in gravel pit *IFL* (33h); and Symondshyde, 10.x.71, fairly common in rich pond, *BSN* (58); and just beyond at Wheathampstead, v-ix.59, taken in MV light trap sited in a small orchard of fruit trees, *IFL* (33h); Waterford, 29.x.64, in gravel workings, common, *BSN* (58); and Gilston, 5.xi.64, in field, *BSN* (58).

Essex. Stifford, near Grays, 11.viii.79, *LJ* (77); Epping Forest, n.d. [prior to 1923], common in ponds, *CN* (35a); (Chingford), 20.xii.12 (adult) & 2.xi.12 (III instar), *EAB* (BM); (High Beach), 22.x.64, 6 adults taken in pond, *BSN* (58); (Loughton), 30.iii.12, *EAB* (BM); 22.x.64, frequent in ponds, *BSN* (58); 25.ix.64, very abundant in ditches and ponds, *BSN* (58); 25.ix.64♀, taken in a farm pond, *BSN* (58); (Wake), 10.ix.60, in bomb-crater, *FB* (18); Waltham Abbey (Cornmill Stream), 22.x.70♀, in rich weedy dyke, *BSN* (58); Epping Plain Lake, 25.ix.64♀, in small lake at woodland edge, *BSN* (58); Lindsey Street, 25.ix.64♂, in rich deep pond, *BSN* (58); Epping Upland (Chambers Farm), 25.ix.64, 2♂♂ in cattle pond, *BSN* (58); (Bury Farm), 25.ix.64♂ in cattle trough, *BSN* (58); Rye Hill (Rivetts Farm) 2 miles SW of Potter Street, 27.x.64, field pond, *BSN* (58); and on the boundary at Harlow Common, 22.x.62, in duck pond on clay, *BSN* (58); and Harlow (Parndon Hall), 5.x.64, frequent in dyke, *BSN* (58).

Kent. Blackheath, 18.viii.59 & 3.x.59, singly in garden pond at 63 Blackheath Park, *AAA* (51); (Round Pond), 7.iv.81 (2♀♀) & 11.vi.82 (nymph, doubtless this speices, quite common), *AAA* (51); Lee (Hither Green Lane), 16.&30.x.1897, pond in field, *WW* (60) (SL) (4) (39) (22); and on the boundary at Gravesend, *GCC* (BM); Filbro' marshes, Gravesend, 5.iv.47, in ditch, *TRES* (13); and Higham Marshes, 7.xi.37 (in dyke), 28.ix.46 (abundant in dyke), *AMM* (70) (22); 13.iv.61, *KCS* (14); 2.v.65, *AMM* (1/**1965**, 57).

Surrey. Richmond Park, 14.v.38, *AEG* (MM); 27.viii.46, in open pond quite close to Ham Gate, *EJP* (68b); 21.iii.54 (11♀♀), in small pond 200 yards from the NW shore of the Upper Pen Pond, *DL* (31i); Putney Heath, 24.viii.46, in small horse pond near the Putney-Wimbledon road about ¼ mile from Tibbetts Corner, *EJP* (68b); Wimbledon, *JAP* (BM); Wimbledon Common, 23.viii.46, in small stream draining Kingsmere towards Roehampton, *EJP* (68b); 23.viii.46, in open pond on S. side of the Portsmouth Road ½ mile SE of Roehampton, *EJP* (68b); 23.iii.54 (1♂, 4♀♀), *DL* (31i); Tadworth, 30.iii.74, pond in Chapel Road, *RRF* (66); Burgh Heath, 18.vii.70, shallow sandy pool near public house, locally common, *BSN* (58); Headley, 7.v.74, in both Stable Pond and Young Pond in Nower Wood, *RRF* (66); Leatherhead, 11.v.24, adults & IV instar larvae, *WEC* (BM); Bookham Common, 4.iv.31 (♂♂ & ♀♀) & 4.vii.53, *FJC* (SL); 28.iv.51 & 29.ix.51, in IOW pond, *DL* (34); Esher Common, 29.x.51, ♂ & ♀, *FJC* (SL); (Black Pond), 23.iii.31♀, *FJC* (1/**1931-32**, 49) (SL); 2.xi.32♀, *FJC* (SL); 15.x.51 ♂♂ & ♀♀, *FJC* (SL); West Molesey, 21.xii.31, *n.c.* (BM); and on the boundary at Byfleet, 8.ix.13 (III & IV instar larvae), *EAB* (BM); 19.viii.55, at MV light, *n.c.* (ex. *S. Wakely* coll.) (C); (Basingstoke Canal), 4.v.47, in neighbouring streams, *SL* (1/**1947-48**, 60); and beyond at Woking, *GCC* (BM); Chobham, vi.1876, *ES* (HD); and in the Basingstoke Canal, 1954-55, found in sections between Lots 20 and 17, towards Frimley Green but not elsewhere, *HDS* (20).

Bucks. Just over the boundary at Cholesbury, 4 miles W. of Chesham, 20.ix.81, *WJLeQ* (21); (Village Pond), 10.xii.71, fairly common in this rich pond, *BSN* (58); and beyond in the Grand Union Canal, on the Bucks/Herts border just S. of Puttenham, 10.ix.71, frequent in the Canal, *BSN* (58); and Sheepcote near Aylesbury, 12.iv.40♀ & 13.iv.40 (♂♂ & ♀♀), in pond, *ESB* (HD).

End of Part XIII

Obituaries

HAROLD WALTER PAYTON, 1904 – 1982

Harold Walter Payton, who died suddenly on 30 September 1982, was born at Brentford, Middlesex, on 28 August 1904, the only son of a well-known local estate agent. His early life was spent in the old Middlesex county town, and after leaving school he joined the staff of the Brentford and District Gas Company, an industry in which he remained for the whole of his working life. After the death of his father he removed to a house in a pleasant semi-woodland area of Harrow-on-the-Hill, where he was able to indulge his interest in natural history, principally ornithology. Although he did not undertake any scientific studies he was very knowledgeable on British birds. He also knew many of the more common plants and contributed records to my *Historical Flora of Middlesex* (1975).

He joined the L.N.H.S. in 1944 and soon became 'resident' lanternist, giving freely of his services and becoming a familiar figure at most meetings for many years. Family ties and old friendships took him regularly to Royston on the Herts-Cambs border, an area for which he had a deep affection, and for a number of years he annually climbed Church Hill on Therfield Heath in the spring to count the number of flowering plants of the pasque flower *Pulsatilla vulgaris*. After his retirement in 1964 he removed to Aldershot and, although his visits to London became less frequent, he retained his enthusiasm for the Society's activities until his death.

Apart from natural history he was much interested in photography and was a lover of classical music, particularly the works of Beethoven and Mozart. He remained unmarried.

D. H. Kent

THOMAS GERALD COLLETT, 1911 – 1982

Thomas Gerald Collett, who died on 20 April 1982, was born at East Tytherton, Wiltshire, on 17 April 1911.

He joined the L.N.H.S. in 1948, and was interested both in botany and ornithology. During the field-work undertaken prior to the publication of *A Hand List of the Plants of the London Area* (1951-1957) he played an active role by surveying the small area of Buckinghamshire contained in the Society's radius, and making a number of new and interesting finds, some with his son Michael, and others in the company of one or the other of the writers. In 1954 he joined the Botany Committee, and in 1962 was elected Chairman of the Botany Section, an office which he held until the end of 1965. During this period he did much to stimulate the work of the Section, and arranged at his own expense the refurbishment of the distintegrating cabinets containing the Society's herbarium. He also held at his Ealing home an annual Christmas party for the members of the Committee – happy occasions not easily forgotten. These are but two examples of the kindness and generosity so typical of the man. In December 1962 he was elected to Council and remained a member until December 1967.

Apart from his botanical interests he was a skilful and enthusiastic photographer and supplied both photographs and plant records to Donald Grose's *Flora of Wiltshire* (1957) and D. H. Kent's *Historical Flora of Middlesex* (1975). He contributed records also to A. E. Wade's *Flora of Monmouthshire* (1970), and voucher specimens of interesting Pembrokeshire plants, collected on family holidays from 1966 onward, were presented to the Welsh National Herbarium at Cardiff.

Indifferent health caused his early retirement, and in 1977 he removed to Ruishton, Somerset, where, despite failing eyesight, he remained cheerful and endeavoured to take an interest in Somerset botany.

M. E. Kennedy and D. H. Kent

Survey of Bookham Common:

FORTY-FIRST YEAR

Progress Report for 1982

General (G. Beven*)

The Survey team was pleased to welcome members of the Quekett Microscopical Club on 13 June and we are glad to report their findings in this report.

Weather notes for the period September 1981 to August 1982 (O. B. J. French†)

Winter struck with a vengeance during December. There were 23 days of frost with a minimum temperature of −12.2°C(10°F) recorded on 30 December 1981, and the addition of nine days of snow made life uncomfortable for man and beast alike. In January the cold weather continued with a similar low temperature being recorded on the fourteenth, and during this month there were thirteen days of frost with heavy falls of snow in blizzard-like conditions on the eighth and ninth, leaving snow thirteen centimetres deep. The year's weather can be summarised, helped by *The Daily Telegraph* monthly weather commentaries: September — warm nights and wet days; October — one of the coldest of the century; November — mild but stormy; December — the worst since 1878; January — very cold; February — a quiet month with a day of red dust from the Sahara mingling with the rain; March — storms and fog, birds hit by hard winter; April — a record for days without rain, but still no official drought; May — a month which blew hot and cold; June — the wettest this century; July — a hot dry month but it still brought floods to some areas; August — warm and wet.

Vegetation (Bryan Radcliffe**).

Juncus × *surrejanus*, the hybrid between jointed rush *J. articulatus* and sharp-flowered rush *J. acutiflorus*, was first described in 1929 from specimens collected in south-east Surrey some forty years before. Since then it has been reported from a number of other counties and it is therefore curious that Surrey botanists appear to have taken no subsequent interest. The hybrid closely resembles *J. acutiflorus* and it is not possible to separate the taxa by superficial examination. The only reliable character is presence or absence of seed, and since this is formed and shed in *J. acutiflorus* over a comparatively short time, it is necessary to keep a specimen under observation for the relevant period.

Late in 1981, when examining rushes at Bookham, we were surprised by the apparent absence of seed in many individuals. It was decided to carry out a more detailed investigation in the following season. The 1982 survey revealed that *J.* × *surrejanus* was locally abundant at Bookham, and in fact greatly outnumbered *J. acutiflorus*. More extensive searches showed that the hybrid is widespread elsewhere in Surrey. So far it has been found abundantly on Thursley and Ockham Commons; on Broadstreet Common, local on Epsom Common and rare on Headley Heath. Survey work on this hybrid will continue at Bookham in 1983. Observations this year suggest that there may be other features of interest requiring investigation.

Other noteworthy plants for the year at Bookham included monkey flower *Mimulus guttatus;* well established in quantity near the Station but hiding its light very effectively in rank nettles; water fern *Azolla filiculoides* in Sheepbell Pond; intermediate wintercress *Barbarea intermedia* found by Commonside. A surprise in this acid habitat was the small sweetbriar *Rosa micrantha;* two bushes thriving on Hollow Path bordering the main chain of ponds. *R. micrantha* is comparatively frequent on the Surrey chalk, but virtually unknown on non-calcareous soils.

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Bryophytes (O. B. J. French).

The enthusiasm and expertise of Rod. Stern have been greatly missed on the Common during the past year, but we are grateful to him for having agreed to act as our referee at long range in cases involving the determination of difficult species. During the past year, Ella Hillman has continued recording over various areas of the Common, while the writer has confined his activities very largely to the study of the epiphytic bryophytes in the woodland areas, a note about which will appear when the work is completed.

Two more species new to the Common have been recorded, one a find dating back to 1980 and only recently correctly determined; no new hepatics have been discovered. In addition, ten moss and one liverwort species, already known to occur on the Common, have been identified in new areas. The species list that follows is based on the nomenclature in *Distribution of Bryophytes in the British Isles — A Census Catalogue of their Occurrence in Vice-Counties* by M. F. W. Corley and M. O. Hill. (British Bryological Society 1981), but synonyms familiar to many people in the *Census Catalogue of British Mosses* by E. F. Warburg (1963) have been quoted in brackets. The habitats, following earlier practice in these notes, are given as in E. M. Hillman, 1975, *Lond. Nat.* **54:** 49-58.

Species	Area	Habitat	Remarks
Polytrichum longirostrum Sw. ex. Brid.	T	6b	New record (1980)
Ceratodon purpureus (Hedw.) Brid.	T	2a	
Dicraus montanum Hedw.	A	7b	New record (on birch).
Campylopus introflexus (Hedw.) Brid.	O	2a	
Phascum cuspidatum Hedw.	Q	2a	
Barbula unguiculata Hedw.	S	2a	
Zygodon viridissimus (Dicks.) R. Br.	AE	7a	
Brachythecium velutinum (Hedw.) Br. Eur.	N	7a	
Plagiothecium denticulatum (Hedw.) Br. Eur.	T	1b	
P. curvifolium Schleiph.	N	1b	
Hypnum cupressiforme var. *resupinatum* (Tayl.) Schimp.	CD	7a	
H. mammillatum (Brid.) Loeske. *(H. cupressiforme* var. *mammillatum* Brid.)	BDH	7a	
Lejeunea ulicina (Tayl.) Tayl.	A	7a,8	

Fungi (Pamela Goldsmith*)

The following species were found during 1982:

April	*Ciboria betulae* (on birch seed)
	Sclerotinia curreyana (on *Juncus*)
	Botrytis cinerea
	Gloniopsis praelonga
	Thecaphora seminis-convolvuli
	Uromyces dactylidis (on *Ranunculus*)
May	*Phoma herbarum* (on an umbellifer)
	Polydesmia pruinosa (on *Diatrype stigma*)
	Laetiporus sulphureus (on willow)
July	*Calocera cornea* (on oak)

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August	*Phellinus pomaceus* (on oak or hawthorn) *Dacrymyces stillatus* (on oak or hawthorn)
September	*Otidea alutacea*
December	*Phellinus ferreus* (or birch)

The help of Dr D. A. Reid and Mr B. Spooner with the identification of the critical or less usual species in this list is gratefully acknowledged.

Invertebrates from freshwater habitats

Platyhelminthes; Turbellaria, Rhabdocoela (J. H. Bratton[*]).

On 29 October 1982 a microturbellarian was abundant in a small pool among rushes on Western Plain 455, and was identified as *Dalyellia viridis* (Shaw) using the keys of Young (1970, 1972). *D. viridis* is noteworthy for being host to unicellular algae (zoochlorellae) which colour the body bright green. The zoochlorellae are thought to be symbionts, utilising the waste products of the turbellarian and partly fulfilling its nutritional and oxygen requirements (Hyman, 1951:193). The pool in which it was found is a temporary water body. It held water on 13 June 1982 but there was no standing water on 8 August 1982. Other invertebrates were present on 29 October 1982 (see below).

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Turbellaria, Tricladida (J. H. Bratton).

No additional species to the 1981 list were found in 1982. New sites for the following two species are:

Polycelis nigra (Müller) 23.1.82 Central Ditch 816.
29.5.82 I. of W. Ditch 815.
Dugesia polychroa (Schmidt) 7.3.82 Central Ditch 816.
29.5.82 I. of W. Ditch 815.

Aschelminthes: Rotifera (C. G. Hussey[†]).

The following species were collected on 13 June 1982:

Brachionus angularis Gosse, 1851. Isle of Wight Pond.
Brachionus calyciflorus spinosus Wierzejski, 1891. I. of W. Pond.
Brachionus rubens Ehrenberg, 1838. Attached to *Daphnia* sp. Upper Eastern Pond.
Keratella cochlearis (Gosse, 1851) I. of W. Pond.
Keratella quadrata (Müller, 1786) Upper Eastern Pond.
Lecane (Monostyla) sp. Bayfield Pond.
Lepadella acuminata (Ehrenberg, 1834) Central or I. of W. Ditch.
Lepadella ovalis (Müller, 1786) Upper Eastern Pond, Upper Hollows Pond.
Mytilina mucronata (Müller, 1773) Upper Hollows Pond, South-Eastern Pond.
Mytilina mucronata spinigera (Ehrenberg, 1832) South-Eastern Pond.
Mytilina ventralis redunca (Ehrenberg, 1837) Lower Eastern Pond, South-Eastern Pond.
Philodina sp. Lower Eastern Pond.
Platyias quadricornis (Ehrenberg, 1832) South-Eastern Pond.
Polyarthra sp. Upper Hollows Pond.
Synchaeta pectinata (Ehrenberg, 1832) Upper Hollows Pond.
Testudinella patina (Hermann, 1783) South-Eastern Pond.
Bdelloids (undet.) Upper Eastern Pond, Bayfield Pond, South-Eastern Pond.

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Nematoda (J. W. Coles*).

Samples of surface mud and debris were collected from I. of W. Pond on 13 June 1982 for the purpose of finding free-living nematodes, but specimens of only one species, *Plectus cirratus* Bastian, 1865, were found mature to be able to identify with any certainty. This was found earlier in I. of W. Pond amongst algae in May 1958 and in mud in March 1961 (1969 *Lond. Nat.* **48**: 128) together with other species of nematodes, before the pond was dredged and cleared of much vegetation. The samples collected in 1982 show an improvement in the condition of the pond for the bottom meiofauna since 1972 when the pond was cleared, having become considerably silted up.

Annelida: Hirudinea (J. H. Bratton)

There are two species of leeches which have been found in new localities:

Glossiphonia complanata (L.)	7.3.82 Central Ditch 816.
	29.5.82 I.of W. Ditch 815.
	8.8.82 Hundred Pound Bridge 187.
Erpobdella testacea (Savigny)	29.5.82 I. of W. Ditch 815.

G. complanata was recorded from Lower Eastern Pond in 1967 (1970 *Lond. Nat.* **49:** 98). *E. testacea* was recorded from I. of W. Pond in 1967 (1968 *Lond. Nat.* **47:** 90).

Mollusca: Gastropoda (J. H. Bratton).

Lymnaea sp. Found in a temporary pool among rushes on Western Plain 455 on 29 October 1982.

Arthropoda: Crustacea (J. H. Bratton).

Daphnia obtusa Kurz. This species, together with calanoid and harpacticoid copepods, was found at the same site on Western Plain 455 and date as the mollusc *Lymnea* sp. reported above.

Coleoptera (G. Beven).

The glow-worm

The glow-worm *Lampyris noctiluca* has probably occurred in most years of the survey but is not recorded every year, partly because members seldom remain after dark during May-July. Dr A. M. Easton (1947) found larvae in February, November and December, under a log and in hay refuse, and 12 dead males were found entangled in a cobweb about a hundred metres south of the Common, while a live male was taken in a house twenty metres from the Common in July 1938. In October 1959 two glow-worms were seen on burned ground on Central Plain 854 (C.P.C.), and in June 1965 two were seen on the I. of Wight 571 and 577 (C.B.A., G.B.). On Central Plain on 11.9.66 E. M. Forsyth found a larva half inside the shell of a snail *Cepaea hortensis,* which it was feeding on 845. In May 1970 A. E. Le Gros saw a larva, 25 mm long, on I. of Wight Path 577, and in July two glow-worms were seen on Central Plain 851 and 859 (D.F.V.F., D.W., M.W.). In June 1975 N. Davies saw three on the Isle of Wight 572, and three by Hollow Path 673, and three were reported near I. of W. Pond, and several on Central Plain 846 (I.G.). 'Plenty' were seen in May 1976 (N.D.), chiefly on Isle of Wight, Bayfield and Eastern Plains and Hollow Path. On 27 July 1976 one was on Common Road (South) at 11 pm., where also in July 1977 there were four (N.D.), and several on Hollow Path. In 1978 one was seen at 10.45 am. in June 841 and in July four were on Bayfield Plain (N.D.). In June 1981 two glow-worms were on Eastern Plain, five along Bank's Path and one on Common Road 579, all between 10.35 and 11.30 pm. (I.S.).

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N. D., N. Davies.
D.F.V.F., D. F. V. Freshwater.
I.G., I. Grant
I.S., I. Swinney.
D.W., D. Warren.
W.W., W. Warren.

Amphibians and Reptiles (G. Beven).

Some early breeding

According to Malcolm Smith (1951), toads *Bufo bufo* (L.) usually migrate to ponds in the south of England in the latter half of March or early April, as for example, at Bookham by 28 March 1964 there were at least 82 in the Isle of Wight Pond, several in cop. and several sitting quietly at the bottom 25 cm. down. But they are sometimes earlier than this at Bookham. In the Isle of Wight Pond for instance. on 12 March 1950 toad spawn was present and on 9 March 1952 toads were very numerous there with pairing and ecstatic posturing occurring. On 12 March 1961 several were in the pond and on 13 March 1966 50 were counted, and on 12 March 1967 there were 46 (G.B.). On 2 March 1977 toads were mating in the pond, and on 12 March 1978 toads were moving towards the Isle of Wight Pond from Hollow Path and on 15 March 1978 30-40 were mating and spawning there (N.D.). The winters of 1949-50, 1951-2, 1960-1, 1965-6 and 1966-7 were regarded as mild, the mean minimum temperature in January varying from 2.5°C to 4.0°C, in February 2.7°C to 6.6°C, and in March 3.4°C to 6.0°C. The winters of 1976-7 and 1977-8 were regarded as fairly cold, the mean minimum temperature being in January, February and March of 1977, 1.4°C 3.2°C and 4.0°C, and of 1978, 1.0°C 1.4°C and 3.6°C, respectively.

Frogs *Rana temporaria* L. return to their ponds to breed in the south-east of England, between mid-February and mid-March (Smith 1951). Curiously, frogs do not seem to have often produced spawn before mid-March at Bookham, although on 13 March 1966 there was frog spawn in the Isle of Wight Pond. However, the autumn of 1953 was very mild, the mean minimum temperature in November 1953 was 6.2°C and in December was 7.4°C, and at that time, this November was regarded as the mildest this century, and December the mildest since 1934. In the first half of January 1954 the weather continued to be mild, and C. J. F. Bensley reported that frog spawn was present in the Isle of Wight Pond in mid-January (Beven 1963). According to Savage (1961) a temperature of 6-7°C in November and December and mild early January is associated with early spawning of frogs, and occasionally spawn is produced during January in Cornwall (Sanders 1937), Devon and parts of Wales (Savage 1961). But there was severe weather at the end of January 1954 and in early February, the mean minimum temperatures were January 2.1°C and February 2.0°C. Ice formed on the Isle of Wight Pond and was still present on 14 February 1954, when G. F. Lawrence noted several crested newts *Triturus cristatus* (Laurenti) and smooth newts *T. vulgaris* (L.) dead and floating in the pond. According to Smith (1951) these newts do not usually move to the ponds until late February or mid-March, and frost and ice occurring after their return to water, does not usually lessen their activities. Did they return to water earlier because of the mild early part of the winter? In this connection it is most interesting to note that in November and December 1949 and in January and February 1950 the mean minimum temperatures were 5.4°C, 5.4°C, 3.7°C and 5.0°C respectively. and on 12 February 1950 a palmate newt *T. helveticus* (Razoumoski) was seen awake but very torpid in the Isle of Wight Pond (Panchen 1951). When in a breeding state the metabolism of frogs is raised and they are liable to drown if the water is covered with ice (Smith 1951), and it appears that occasionally newts may also drown.

Hibernation

On 28 February 1981 Ian Swinney found a hibernating crested newt in a slight depression in the ground under one or two pieces of firewood in his garden 571. On 27 September 1978 Nigel Davies dug up a smooth newt from the dam of South-east Pond, 7.5 cm. from the water and 30 cm. from the top of the dam. He also dug up a male smooth newt from a disused nest of the yellow meadow ant *Lasius flavus* Fab. in Central Wood 565 on 14 October 1978. Colin Rees on 22 October 1978 dug up a smooth newt from the floor of Gunpit C, 4 cm. below the surface. Two hibernating smooth newts were found on 23 November 1981 among leaves on the ground under large logs in a wood stack on Hollows path 676 and there was a sleepy female 5 cm. deep in soil in his garden 571 on 6 January 1983 (I.S.). On 4 November 1977 a very sleepy newt (probably a palmate) was dug up 7.5 cm. down in the dam of Lower Eastern Pond (N.D.). Unfortunately the spade chopped off a right leg.

Malcolm Smith (1951) writes — 'Newts normally hibernate on land — in late October or November they creep into holes in the ground or under stones or logs or into piles of leaves. Newts, with their weak limbs, cannot burrow, but find their way into cracks and holes that have already been formed. The power to regenerate parts of the body — such as the limbs — is maintained by the Caudata throughout life.' But is presumably less likely to occur during hibernation.

A hibernating common toad was found among grass roots in Western Scrub on 14 March 1982. On 6 January 1983 two were found, a male and a female, about 25 cm. apart and about 7 cm. deep in garden soil 571. When moved they were able to crawl slowly under some leaves of a foxglove (I.S.). According to Smith (1951), toads hibernate on land. Dry banks are favourite spots, especially where trees and hedges give extra protection, and they often select disused burrows of mammals. Frogs hibernate at the bottom or sides of ponds, or in holes away from water, but no cases of hibernation have so far been found at Bookham. Smith also states that frogs usually start hibernation in October or November, but it may not be continuous during a mild winter, the frogs appearing during mild weather and disappearing when it is cold. Even so they are difficult to find, but in mid-January 1954, frogs actually produced spawn, when the weather was mild (C.J.F.B., see above). Frogs are more easily detected by owls, and frog bones are found in the pellets of tawny owls at Bookham, but so far only in the summer. However, from 1968-74 tawny owl pellets were collected regularly and frequently at Hampstead Heath, where two frogs were taken in December and three in February, and at Esher, Surrey, where 19 were taken in November (G.B.).

On 4 March 1976 N. Davies found a common lizard *Lacerta vivipara* Jacquin in a torpid condition under a brick in his garden 571. A hole in the ground or a deep crevice among stones are probably the most likely places for hibernation.

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Reptiles (O. B. J. French).

Adders galore in days of yore

Adders *Vipera berus* (L.) are scarce on Bookham Common these days, but it seems they may have been abundant sixty years ago. An elderly acquaintance of mine who used to reside in Bookham, tells me that between 1919 and 1924 he worked at Gillets, as the Wildts factory opposite Bookham Station used to be called. During that period a team of two or three 'rough looking chaps' used to arrive each year by train from London's East End. They were equipped with closely-woven rush baskets with lids that were secured by toggles, and these were used to hold the adders caught on the Common. The men used to search an area between two ponds, South-eastern Pond and possibly Upper Eastern Pond. My friend used to watch them at work and says they always made sizeable collections. The adder catchers told him that the snakes, on arrival in London, were boiled to extract their oil, which was then made into adder ointment, a specific for the relief of sore eyes, and was sold in the East End.

Birds (G. Beven).

Population Studies in Oakwood

The breeding season census was repeated in the 16-hectare sample of dense pedunculate oakwood in 1982 by Andrew Merritt. Unfortunately only six counts could be made between March and July, so that the figures may be underestimates. Corrections were made for 1981 of the territories of wren to 23 and great tit to 22. Thus in 1978, 1979, 1981 and 1982 the wren territories were 33, 18, 23 and 33, the blackbird 11, 13, 20 and 14, and the robin 40, 41, 28 and 28 respectively. These suggest that the wren population has recovered, while the blackbirds have reverted to about their usual population, whereas the robin numbers have remained rather low. The great tits have reverted to near their normal, the figures for the same years being 13, 16, 22 and 16 but the number of blue tits again showed little change.

Population Studies in Scrub and Grassland

The breeding season census was repeated in 39 hectares scrub and grassland in 1982 by D. A. Boyd and W. D. Melluish. The number of territories for 1979, 1980, 1981 and 1982 respectively were, for wrens 18, 10, 17 and 16, for robins 40, 33, 20 and 20, and for blackbirds 21, 27, 25 and 19. Thus the wren and robin populations have remained much the same while the number of blackbirds has decreased.

Other Notes on the Birds

Little grebes nested on Eastern Hollow Pond and produced three chicks. As usual kestrels frequented the plains and a pair of sparrowhawks hunted there regularly and were also observed in Eastern Wood (D.A.B., W.D.M., A.M.).

Rooks and Jackdaws on Bookham Common

Flocks of rooks are frequently seen flying over the Common but do not often feed there. Just outside the Common in Lady Chewton's Wood (sq.23) there was a rookery which had 22 nests in 1942 (Carrington *et al.* 1944), and about 50 nests in 1957 (G.B.). However, the larger trees were felled soon after and in 1968 there was no sign of a rookery. In 1969 a rookery of 21 nests was present near Little Bookham Church about a mile south of the Common (G.B.). In 1943 (Carrington *et al.* 1944) jackdaws were fairly commonly seen flying over, but still seldom visit the Common. In early 1969 a colony of 4-5 pairs was noted by Great Bookham Church ¾ mile south of the Common (C.H.).

However members of the Corvidae do visit the oakwoods on the Common when the defoliating caterpillars are full grown and descend on 'silken' threads, from the canopy to the ground to pupate, during the last week in May and the first two weeks in June. Insectivorous birds nesting in the woods feed extensively on these, but in addition other birds enter the wood for the feast. Many blackbirds join the resident birds and large numbers of starlings with their young, in parties of 20-50, occasionally 300-400 (G.B., E.M.H.). Rooks and jackdaws may also visit the canopy in flocks of 100-200 with occasionally ten or so carrion crows to feed on the caterpillars (E.M.H., D.A.R.), and parties of 35-40 rooks were observed circling over Hill House and Central Woods on 25 May and 1, 2 and 4 June 1980, probably to join in the feast (I.S.).

Flocking of Carrion Crows

In late August 1966 there was a flock of about 50 carrion crows in Sheepbell Wood 3845 (K.G.). On 13 January 1974 at dusk several carrion crows flew over Eastern Wood calling loudly, and they then joined others to form a flock of about 50 birds in South-east Wood 678. The birds were often flying round calling and settling in trees (G.B.). On 10 February 1974 a party of 15 were flying south-east across Central Plain at dusk (G.B.) and a flock of 50-60 birds assembled at dusk in South-east Wood, and they later flew to Eastern Wood with six magpies (M.T.). Franklin Coombs (1978) writes — 'Communal winter roosting of carrion crows is probably their normal habit. They gather at pre-roost assemblies — outside the nesting area. They may roost with other species of crows.'

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Mammals (G. Beven)

The Dormouse

On 26 January 1982 Ian Swinney found a dormouse *Muscardinus avellanarius* about 200 metres south of the Isle of Wight Pond 813. It was in a nest on the ground among leaves at the foot of an oak tree. The nest was constructed of leaves and grasses, the grasses being wrapped in all directions, making an almost inpenetrable wall. The dormouse was cold when found but began to stir after half an hour, when it began to warm up, and when disturbed it emitted a high pitched squeak. Ian Swinney has described how he kept the dormouse until the spring. He used a cage with bracken and leaves put in for cover. The cage was placed in a room in the Keeper's cottage 571, the window being left open to keep the temperature as near as possible to that outside. Food put in was 'mouse food' from a petshop, containing seeds, e.g. sunflower seed, corn and biscuit, and some of this was eaten and some water drunk from a bowl.

The dormouse spent much of its time asleep during the next two months, but at times it woke and took some food even during February. On 21 February a toilet roll cardboard centre was given for the dormouse to chew on but instead it used it as a nest. On 27 February the dormouse was awake and the weather was mild. During March, although it slept a great deal, it was found awake with increasing frequency, and on the 12th was climbing on twigs. Hibernation in captivity is not normally continuous, with several days of activity alternating with two or three weeks of sleep (Hurrell 1962), but it is apparently unknown whether hibernation in the wild is discontinuous. From 15 April onwards it became more active at night although still often asleep in the daytime. On 20 April the dormouse escaped through a hole in the cage. The door of the room was kept shut but the window was left open. Food was still being taken on 22 April but none afterwards, so the dormouse had presumably returned to the wild.

There have been two previous records of hibernating dormice in 5683 and 763, and an active one seen in August in sq. 55. Also the bones of one were found in a tawny owl pellet in Eastern Wood in June 1964.

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Book Reviews

The Breeding Birds of Europe: A Photographic Handbook. Part One. Divers to Auks. By Manfred Pforr and Alfred Limbrunner. Translated by Richard Stoneham and edited by Iain Robertson. Croom Helm, London. 1981. 325 pp. £14.95.

This is the first of two volumes described as a photographic handbook. This volume deals with divers to auks and the projected second volume will show the remaining birds from sandgrouse to crows. This production originated from West Germany and was compiled by Manfred Pforr and Alfred Limbrunner. They have used photographs supplied by over 40 European experts and the format is that each bird has two pages devoted to it. The left-hand page is entirely taken up with a photograph of the bird in its habitat, and this is the book's chief delight, each picture being of magnificent quality. For this alone it is capable of being browsed through again and again.

The right-hand page consists of some text, a distribution map particularly well-placed in the top right-hand corner for easy comparison, and usually three small photos, two of which show eggs and nestlings if it has been possible to photograph them without disturbance. The remaining photo unfortunately shows little consistency. Sometimes a juvenile is shown, or it can be a bird in flight, or displaying and so on. However, the authors stress firstly, that identification is not the book's main object, but that they aim to provide pictures of the adult bird together with nest and eggs; and secondly, that in some cases it was not possible to obtain adequate photographs of a particular species.

This has led to some birds having to be omitted altogether, and although the number of these is quite small it does include some whose omission is annoying such as great northern diver, grey phalarope and white-winged black tern. One would have welcomed less perfect photos of some of these species balanced, with cost in mind, by the exclusion from this British edition of some species that are abundant and widespread, mallard and pheasant for instance.

However, this is going to prove a delightful book to own and one which is going to be turned to at an early stage to check points of identification, at least by the not-so-expert, despite the authors' disclaimer. Furthermore, just as most ornithologists love lectures with films or slides, they may well be going to turn increasingly to these new books of photographs rather than to drawings – and not necessarily to photographs as select as these are. After all, most birds we see are silhouettes on the far side of the reservoir or blurs flying past, and it may be that a photographic record of birds in some of the identifiable ways we actually see them will become available in future.

G. A. Wheeler

London Cemeteries. An Illustrated Guide and Gazetteer. By Hugh Meller. Avebury Publishing Company, Amersham, 1981, 318 pp., 90 black and white photographs. £15, paperback £7.95.

Hugh Meller is on the staff of the National Trust. He visited all the 100 cemeteries described, which are situated within nine miles of central London and covering approximately 3,000 acres, from the City of London Cemetery, with 130 acres, to some of less than one acre.

The book is written in such an interesting and readable style that one feels prompted to visit many of the cemeteries described. It covers such a wide field that only two pages are devoted to the *Flora and fauna*, section, but each cemetery is treated individually. Mitcham Cemetery contains a tomb with a tragic tale, of Mary, Sarah and Eliza Atwood, 'who were poisoned by eating funguous vegetables mistaken for champignons on the 11th day of October 1808 at the ages of 14, 7 and 5 years within a few hours of each other in excrutiating circumstances....This monument is erected to perpetuate the fatal event as an awful caution to others....' The excellent work of the Friends of Highgate Trust is mentioned as also the devastation of a number of others including Norwood by the Lambeth Council who have cleared all the undergrowth and broken up many of the lichen-covered monuments, in order to make yet another grassed park desert. A golden opportunity for detailed natural history surveys seems to have been practically lost.

The book is a valuable record of changing attitudes.

Rosa Davis

The Bryophyte Flora of Bookham Common

by R. C. Stern* and O. B. J. French†

Summary

A complete list of all hepatics and mosses recorded during a nine-year period until the end of 1981 is given, together with the distribution in the survey area and notes on abundance and habitat. A comparison is made with a previous survey carried out mainly 30-40 years ago, and some suggestions are made as to why there are some significant differences in distribution and abundance betwen then and now.

Introduction

Towards the end of 1972, R.C.S. commenced recording bryophytes in addition to the study of particular groups of vascular plants which he was undertaking at the request of the Society's Bookham Common Survey Committee (Stern 1975). At that time little had been published on the Bookham bryophytes, but, in 1975, Miss E. M. Hillman produced a most valuable account of the records accumulated by Messrs Castell and Peterken between 1941 and 1967 (Hillman 1975). This paper included the records of R.C.S. over a period of about eighteen months until 1974 and a short report by him in an appendix.

It appeared that there were a number of significant changes, although the survey between 1972 and 1974 was not comprehensive, and R.C.S. decided to continue recording bryophytes on a more systematic basis. In 1974 he moved to West Sussex and was unable to visit the Common as frequently as previously, but others, including Miss Hillman and J. C. Gardiner, made useful contributions. In 1977, O.B.J.F., living locally, started visiting two or three days a month for bryophyte recording. Notes on new discoveries have been published in the Progress Reports for the years 1976-1981 (*Lond. Nat.* **56-61**).

The Flora

The arrangement of the Flora is based on Corley and Hill (1981). As there are many name changes from previous check-lists, reference is made, where appropriate, to the old names. A total of 114 taxa have been recorded, comprising 21 hepatics and 93 mosses, a fairly impressive list for a lowland situation on a uniform geological formation. The numbers reflect the variety of habitats on the Common, including different types of aquatic environment; and also, to some extent, the relative intensity of investigation which is shown up by the substantial number of species which have only been found in one or two restricted localities. The Bookham Common Survey 'areas' have been used for recording, and a key map is reproduced.

The most abundant mosses in the woodland are *Atrichum undulatum, Dicranella heteromalla, Fissidens bryoides, Mnium hornum, Hypnum cupressiforme* and *Eurhynchium praelongum*. These occur in all, or nearly all, of the twenty areas and are typical of the neutral or mildly acid conditions of the woodland floor. Liverworts are not common. except for *Lophocolea heterophylla* which occurs in all the areas. The rather more acid conditions of Eastern Plain are suitable for species of *Polytrichum* and *Campylopus* which are rare or absent elsewhere.

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The trunks of ancient oaks which dominate most of the long-established woodland are not generally favourable to epiphytes other than *Hypnum cupressiforme,* although their horizontal boughs often support luxuriant floras. Similarly, the young oaks are generally barren of bryophytes and it is those of middle age with diameters of twelve inches or more which bear the best growth of epiphytes on their boles. Other species also have a good assemblage of epiphytes, such as *Aulacomnium androgynum, Zygodon viridissimus, Orthotrichum* spp. and *Metzgeria furcata.* The elders which have colonised some of the scrub associations are particularly rich in these species; ash, field maple and willows growing on marshy ground are also quite good for epiphytes.

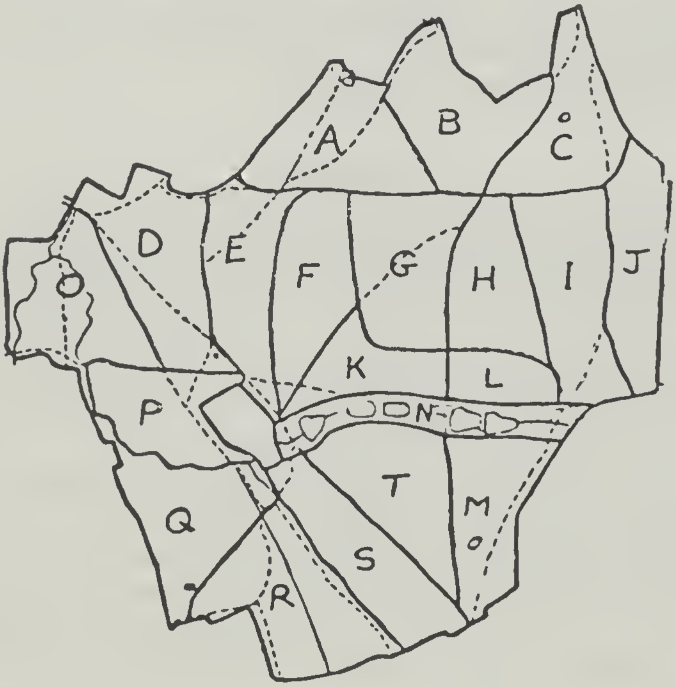

Fig. 1. The Bookham Common Survey areas.

Some of the less common species tend to occur in the more specialised habitat, aquatic situations including dried-up ponds, disturbed ground of one sort or another, and bare ground on rides and tracks. The most uncommon species in the context of *A Bryophyte Flora of Surrey* (Gardiner, 1981) are *Polytrichum longisetum, Dicranum tauricum, Fissidens exilis, Physcomitrella patens, Ulota crispa, Calliergon cordifolium, Scapania irrigua* and *Radula complanata.* Some of these are well estabished and should survive indefinitely, but others are ephemeral or precarious and may disappear in the future.

Comparison with previous records

One of the most valuable features of the Bookham Common Survey is its long-term and continuing nature. There are, therefore, unique opportunities of comparing the records from time to time, and of monitoring change.

Taking first of all the 'new' species, i.e. those not recorded before 1967, the principal ones of interest are *Tetraphis pellucida, Dicranum tauricum, Pohlia carnea, Orthodontium lineare, Zygodon conoideus* (the first record for V.C. 17 when O.B.J.F. found it), *Orthotrichum diaphanum, Leskea polycarpa* and *Lejeunea ulicina*. In some cases (especialy *Orthodontium* and *Campylopus*) the species were very rare nationally in the 1940's, but have spread dramatically since then. In other cases, the addition of new habitats, such as more elders for epiphytes, has been the reason, but there are one or two species which one would have expected to have been present previously, although they might have been overlooked (e.g. *Pohlia carnea*).

Although hepatics are not generally common, the indications are that they were even less so in the 1940's. This certainly appears to apply to the epiphytes, with *Metzgeria furcata* and *Lejeunea ulicina* being more abundant than previously recorded. It is possible that Castell and Peterken paid more attention to the terrestial bryophytes than to the epiphytes, although this seems unlikely. If the epiphytes have really increased in the last 20 or 30 years, it may be associated with a decline in atmospheric pollution. This is not in accordance with the findings on lichens (Laundon 1981), but possibly recolonisation by certain bryophytes may be more rapid than by lichens.

Generally speaking, bryophytes appear to be more widely distributed than they were previously, with most species now recorded from more areas than before. It must be borne in mind, however, that the intensity of recording may have been greater during the 1970's than it was in the 1940's. Looking at the species which are no longer present, or which have significantly declined, it will be seen that they include *Sphagnum auriculatum, Aulacomnium palustre* and *Hypnum jutlandicum*. These are generally mosses of relatively open, heathy or boggy ground, and it is almost certainly the decline of this habitat which has resulted in the reduction of these species. In Area D in particular, the heathy areas have been completely colonised by woody growth, and on Eastern Plain it is only the artificial cutting of the vegetation which enables these species to survive.

The scrub which has replaced the open grassland and heathy areas has some interesting species, particularly as epiphytes. These are now developing into oak woods which have similar bryophyte associations to the older, long-established woods. The group felling which is now being carried out in the older woods provides new habitats and much more light and should help in perpetuating the variety and abundance of bryophytes at Bookham.

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Systematic list of species follows:-

Systematic list of the Bryophytes of Bookham Common, 1972-1981.

Species (synonyms in brackets)	Distribution (1941-1967 records in brackets)	Abundance and habitat notes
1. HEPATICAE		
Lunularia cruciata	(1) 6 JOPQRS	Occasional; present in abundance on some culvert sides and stream banks by water's edge.
Marchantia polymorpha	(1) 1 E	Very rare; single record from burnt ground.
Riccia fluitans	(5) 5 CDMNQ	Occasional; sometimes abundant in ponds, usually mixed with *Lemna* spp., once in fist-sized balls, floating just below the surface and surviving under ice cover in the winter 1978/1979.
Metzgeria temperata	(–) 1 O	Very rare; single large colony on *Quercus cerris*.
M. furcata	(1) 9 ABCEFIKST	Frequent; corticolous on oak; found once with capsules.
Pellia epiphylla	(4) 11 FGHIKNOPQRS	Frequent; colonises muddy ditch sides, sometimes in abundance; capsules present at times.
P. endiviifolia	(–) 1 Q	Very rare; single record from bank of stream.
Fossombronia wondraczekii	(1) 2 FG	Rare; two records only from muddy woodland rides; with capsules.
Lophocolea bidentata	(10) 2 AH	Rare; on grassland.
L. cuspidata	(8) 14 ABCDFGIJKLNOPT	Common; mainly on stumps and tree trunks.
L. heterophylla	(12) 20 ALL AREAS.	Very common; on rotten wood, trees and banks; capsules common.
Chiloscyphus polyanthos	(–) 1 N	Very rare; single record from muddy pond margin.
Diplophyllum albicans	(–) 2 HN	Rare; from bare ground.
Scapania irrigua	(–) 1 D	Very rare; single record from bare ground.
Cephalozia bicuspidata	(3) 6 BCDHLT	Occasional; on bare ground surrounding trees in open, heathy places.
C. connivens	(–) 1 T	Very rare; single record from heathy ground in woodland clearing.
Calypogeia fissa	(9) 12 DEGHIJKMNOTS	Frequent; on sides of gunpits and in woodland clearings; gemmae present.
C. arguta	(–) 3 HLT	Rare; on the sides of ponds and ditches; gemmae present.
Radula complanata	(2) 1 O	Very rare; single record from fallen *Salix fragilis*; now scarce in Surrey.
Frullania dilatata	(3) 6 DFKLOS	Occasional; corticolous chiefly on old elders.
Lejeunea ulicina	(–) 9 ABEFGHIKO	Frequent epiphyte; usually a few scattered stems, but sometimes abundant.

2. MUSCI

Sphagnum auriculatum (*S. subsecundum* var. *auriculatum*)	(2) 1 T	Very rare; wet heath on Eastern Plain.
Tetraphis pellucida	(–) 5 ADIJP	Occasional; mainly on rotten wood; gemmae present.
Polytrichum longisetum (*P. aurantiacum*)	(–) 1 T	Very rare; rim of hollow on edge of Eastern Plain.
P. formosum	(10) 12 ACDEJKLMNPST	Frequent; in woodland clearings, on grassy pond banks etc.; commonly with capsules.
P. commune	(–) 1 T	Very rare; wet heath on Eastern Plain.
P. juniperinum	(6) 4 MNOT	Occasional; sometimes abundant in heathy areas; often with capsules.
Atrichum undulatum	(16) 20 All areas	Very common; in moist, shady areas, particularly beside woodland rides; frequently with capsules.
Pleuridium acuminatum	(9) 4 FINO	Occasional; on woodland floor; capsules usually present.
Pseudephemerum nitidum	(4) 11 DEFIJKMNOPT	Frequent; on damp rides and banks; sometimes a pioneer species on disturbed soil; usually with capsules.
Ditrichum cylindricum	(–) 1 D	Very rare; single record from path through trees; rhizoidal gemmae present.
Ceratodon purpureus	(12) 15 ACDEFIJKMNOPQR	Frequent; found in a wide variety of habitats; commonly with capsules.
Dicranella heteromalla	(16) 20 All areas	Very common; abundant in woodland, on the ground, on banks, tree bases and stumps; usually with capsules.
Dicranoweisia cirrata	(14) 20 All areas	Very common epiphyte; forming patches and cushions on trunks and horizontal oak boughs; capsules often present.
Dicranum bonjeanii	(1) 1 O	Very rare; single record from rabbit-grazed area.
D. scoparium	(7) 11	Frequent; chiefly on bases of trees and on rotten stumps.
D. montanum	(–) 1 A	Very rare; single record of immature plants on base of birch.
D. tauricum (*D. strictum*)	(–) 4 BFGT	Rare epiphyte; apparently increasing.
Campylopus pyriformis	(1) 5 DGPTS	Occasional; on rotten tree stumps, sometimes abundant on acid heath, often in association with *C. introflexus*.
C. paradoxus (*C. flexuosus*)	(3) 6 DGMPST	Occasional; on acid heath and rotten tree stumps.
C. introflexus	(–) 8 DEMNPQST	Occasional but increasing; on acid heath often in association with *C. pyriformis*; capsules rare.
Fissidens bryoides	(13) 17 ABDFGHIJKLMNOPRST	Common; on woodland floor, banks and ditch sides; usually with capsules.
F. exilis	(3) 8 DIJLMNPS	Frequent; in scattered colonies on woodland floor and on shaded grassland; capsules present.

F. taxifolius	(11) 10 ADHJMNOPQS	Frequent; on woodland floor; capsules sometimes present.
Totula laevipila	(1) 1 S	Very rare; single record from prone trunk of *Salix fragilis*.
T. muralis	(5) 10 DJMNOPQRST	Frequent; on brickwork of culverts and railway tunnels; usually with capsules.
T. latifolia	(–) 1 D	Very rare; single record from tree base by stream.
Pottia truncata	(6) 6 ADHNOP	Occasional; on bare ground; capsules usually present.
Phascum cuspidatum	(2) 1 O	Very rare; single record from bare ground recently cleared of scrub; capsules present.
Barbula convoluta	(4) 1 N	Very rare; single record from gravel.
B. unguiculata	(2) 2 NO	Rare; on soil and brickwork.
B. revoluta	(–) 2 NO	Rare; on brickwork.
B. fallax	(1) 2 DP	Rare; on bare ground.
B. trifaria	(–) 1 N	Very rare; on concrete overflow pipe of pond.
B. recuvirostra	(–) 3 MOT	Rare; on brickwork.
Grimmia pulvinata	(2) 7 DMNPQRS	Frequent; on brickwork; capsules usually present.
Funaria hygrometrica	(12) 7 CEINORT	Frequent; on bare ground and on burnt areas; capsules usually present.
Physcomitrella patens	(1) 2 AN	Rare; a summer ephemeral on exposed, dry mud of ponds; sometimes abundant in suitable localities; capsules usually present.
Ephemerum serratum var. *minutissimum*	(1) 2 FJ	Rare; an ephemeral of shady rides and ditches, usually in association with other bryophytes; capsules present.
Orthodontium lineare	(–) 12 ACDGIKMPQST	Frequent; on tree bases and stumps; often with capsules.
Pohlia nutans	(9) 9 BEKMNOQST	Frequent; on stumps and heathy areas; sometimes with capsules.
P. carnea (P. delicatula)	(–) 7 GMNOPQT	Frequent; on banks of stream and ditches.
Bryum capillare	(5) 10 ADMNOPQRST	Frequent; in a wide range of habitats — walls, trees, bare soil, etc., often with capsules.
B. flaccidum	(–) 1 O	Very rare; single record from old elder.
B. bicolor	(7) 5 MNORS	Occasional; on bare ground; gemmae present.
B. argenteum	(6) 10 DIMNOPQRST	Frequent; usually on brickwork; rarely with capsules.
B. klinggraeffii	(–) 1 N	Very rare; single record from soil by pond.
B. microerythrocarpum	(2) 2NO	Rare; records from bare ground; gemmae present.
B. rubens	(3) 6 DINORT	Frequent; on grassy areas and woodland floor; gemmae present on rhizoids.
Mnium hornum	(12) 19 ABCEFGHIJKLMNOPQRST	Very common; on woodland floor, rotten wood and a variety of other habitats; capsules often present.

Rhizomnium punctatum (Mnium punctatum)	(1) 4 ABNO	Occasional; on woodland floor.
Plagiomnium affine (Mnium affine)	(2) 1 S	Very rare; single record from fallen trunk of *Salix fragilis*.
P. undulatum (Mnium undulatum)	(3) 5 ADNOR	Occasional; on woodland floor.
Aulacomnium palustre	(3) 1 D	Very rare; single record from heathy area.
A. androgynum	(2) 12 ABEGIJMOPRST	Frequent; on rotting wood; gemmae present.
Zygodon viridissimus	(1) 10 ABCDFILOQS	Frequent; small patches on trees; gemmae present.
Z. conoideus	(–) 1 C	Very rare; single record from *Quercus cerris*, an unusual host; gemmae present; first Surrey record.
Orthotrichum affine	(–) 5 ACDOR	Occasional; mainly on elders; frequently with capsules.
O. diaphanum	(–) 7 ADEMNOR	Frequent; mainly on elders; frequenty with capsules.
Ulota crispa	(2) 3 ANO	Rare; seen only in small tufts on three oaks; capsules present.
Leskea polycarpa	(–) 2 OP	Rare; three records from roots of *Salix* spp. subject to inundation on stream banks; capsules often prolific.
Thuidium tamariscinum	(6) 3 GKL	Rare; on ground near ditches in damp woodland situations; once found with capsules.
Cratoneuron filicinum	(1) 1 O	Very rare; single record from marshy ground.
Amblystegium serpens	(5) 11 ADJMNOPQRST	Frequent; on woodland floor and rotten wood; capsules often present.
A. riparium (Leptodictium riparium)	(4) 8 ANOPQRST	Frequent; on banks and on tree roots in ponds; capsules sometimes present.
Drepanocladus aduncus	(3) 1 D	Very rare; single record from side of bomb crater.
Calliergon cordifolium (Acrocladium cordifolium)	(–) 2 CR	Rare; on rotten wood in pond shallows.
C. cuspidatum (Acrocladium cuspidatum)	(5) 5 DGFNO	Occasional; on damp, bare ground and sides of ponds.
Isothecium myurum	(–) 2 FN	Rare; on brickwork of culverts; capsules present.
I. myosuroides	(6) 9 ADFHIJNOT	Frequent; on tree bases and woodland floor; capsules occasional.
Homalothecium sericeum (Camptothecium sericeum)	(3) 7 DHNPQRS	Occasional; on brickwork; capsules rarely present.

Brachythecium albicans	(5) 1 D	Very rare; single record of scattered stems on gravelly area near Hundred Pound Bridge.
B. rutabulum	(20) 20 All areas	Very common; in a wide variety of habitats, particularly grassland; capsules usually present.
B. velutinum	(6) 8 ABDNOQRS	Occasional; in various habitats, especially on dead wood; capsules usually present.
Pseudoscleropodium purum	(15) 10 DEGIMNOPRST	Frequent; particularly on grassland and scrub verge.
Cirriphyllum piliferum	(2) 1 D	Very rare; single record from woodland floor.
Rhynchostegium riparioides	(–) 1 D	Ver rare; single record from new pond.
R. confertum (Eurhynchium confertum)	(5) 7 AJNPQRS	Occasional; on concrete and brickwork; capsules frequent.
Eurhynchium striatum	(3) 3 ACP	Rare; on woodland floor.
E. pumilum (Rhynchostegiella pumila)	(3) 1 O	Very rare; on woodland floor.
E. praelongum	(17) 20 All areas	Very common; on woodland floor, rides, tree bases and trunks; capsules occasional.
E. praelongum var. *stokesii*	(–) 1 C	Very rare; on woodland floor.
E. swartzii	(2) 3 ADJOP	Occasional; on bare ground and banks.
Plagiothecium denticulatum	(5) 14 ABCDIJKLONPQRS	Common; on tree bases and stumps, sometimes on banks in woodland; capsules frequent.
P. succulentum	(–) 5 ABEGO	Occasional; on pond sides, rotten wood and forest floor.
P. curvifolium	(–) 9 ABCGHKNST	Occasional; on ditch sides, banks, tree bases and stumps; capsules occasional.
P. nemorale (P. sylvaticum)	(2) 6 ABDJNT	Occasional; on woodland floor and ditch sides.
Isopterygium elegans	(2) 8 ABCFIKNT	Occasional; on banks in woodland.
Hypnum cupressiforme var. *cupressiforme*	(16) 20 All areas	Very common; occurs commonly as an epiphyte and on grassland; capsules sometimes present.
H. cupressiforme var. *resupinatum*	(4) 4 ADIS	Rare; on tree trunks.
H. mammillatum (H. cupressiforme var. *filiforme)*	(–) 3 AHI	Rare; on tree trunks.
H. jutlandicum (H. cupressiforme var. *ericetorum)*	(3) 4 DFGN	Rare; on heathy ground.
Rhytidiadelphus squarrosus	(8) 8 DEFGMNST	Frequent; on grassland and woodland rides.

Botanical Records for 1982

by R. M. BURTON*

Summary

Outstanding records from the London area in 1982 include many halophytes by main roads in Kent, *Centranthus calcitrapa* as a more or less established alien in Surrey, *Trifolium striatum* in north Essex, *Dactylorchis incarnata* in two places in Herts and *Trifolium glomeratum* and *T. scabrum* in Middlesex.

Introduction

The outstanding features of the weather in 1982, which were some exceptionally low temperatures at the beginning of the year and unusually heavy rainfall in September, were not of a kind to have any lasting effect on the flora of the area covered by this account of botanical discoveries made in that year. The recording area of the London Natural History Society, which extends about 32 km in all directions from St Paul's Cathedral, is divided for recording purposes into squares of size 2×2 km, numbered (e.g. 25T82) according to a system explained by Sandford (1972). In this account it is also divided according to the counties as they were before the formation of the county of London, numbered in the sequence devised by Watson (1873).

Before reading about the finds of 1982, please pause for a moment in memory of R. A. R. Clarke who died in that year. Mr Clarke, though never a member of this Society, was a good friend of it. He led many field excursions for us in east Surrey and adjacent Kent and over a long period sent lists of his botanical discoveries to the Society's recorder. He was a leading spirit in the recent endeavours of the Croydon Natural History and Scientific Society to produce an up-to-date account of the flora of their area and will be sadly missed by Surrey botanists. He always conducted his own explorations on foot, so developing an intimate knowledge of the plants, especially the smaller and more difficult ones, of the area around Warlingham where he lived. Many fine observations were his, most recently *Bromus benekenii* found at Warlingham (35T46) in 1981. I do not know that he published anything himself, but he contributed plant lists to printed accounts of Selsdon Wood and the Sevenoaks Wildfowl Reserve. In 1982 his widow published privately *Seventy years of nature notes in Warlingham and Chelsham: Arthur Beadell's notes on flowers, re-issued and updated by Raymond Clarke*. Those who knew Clarke will be amazed to find his mannerisms of speech reproduced exactly in the tiny print of this booklet. There are hopes of getting his Shakespearean studies published also.

Records

V.C. 16, West Kent

By far the most interesting collection of records received from the south-east part of our area are those submitted by G. D. Kitchener, which are almost entirely confined to the sides of main roads, continuing and greatly intensifying earlier studies made further into Kent and elsewhere into the distribution of halophytic (salt-loving) species away from the sea. It is well known how salt is increasingly being applied in winter to frozen roads to assist thawing; after each application salty slush is sprayed by passing vehicles onto the first metre or less of roadside. As may be expected in the light of experience elsewhere (Scott and Davison 1982, Cusick 1982), *Puccinella distans*, found by the A2, A21, A25, A225, A282 and Childsbridge Lane, Kemsing, is the most abundant, with records from 24 tetrads, but *P. fasciculata* and *P. rupestris* were also both found by the A21 east of Chevening (45T86) and more numerously farther south beyond our boundary. Other grasses seen were *Parapholis strigosa* by the A2 in four tetrads from

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*Sparepenny Cottage, Sparepenny Lane, Eynsford, Kent DA4 0JJ.

Dartford (57T42) eastwards and between Eynsford and Shoreham (56T22), *Hordeum jubatum* (perhaps a maritime plant in its native American range which is difficult to determine) between the carriageways of the A2 near Hawley (57T42) and Swanscombe Park (57T82), *H. marinum* in a similar situation near Wilmington (57T22), *Agropyron pungens* on Dartford Heath (57T02) and *Catapodium marinum*, which is long extinct as a wild plant in the London area, by the A25 at Chipstead (55T04). Slightly farther west (45T84) Mr Kitchener found a single plant of *Apera spica-venti* which might have been brought here in some similar way though it is not naturally a seaside plant. Besides the grasses, six other halophytes appear in his roadside records. *Aster tripolium* was abundant and conspicuous along the centre strip of the A2 from Dartford Heath (57T02) to Swanscombe Park (57T82). The same length of road produced *Spergularia marina* which was also in one place by the A21 below Polhill (55T08). Four tetrads along the A2 (and many more eastwards to Rochester) had *Atriplex littoralis*. In one (57T22) there was also a single flourishing plant of the dwarf shrub *Halimione portulacoides*. Near Hawley (57T42) the central reservation of the A2 had a small patch of *Bupleurum tenuissimum*, another species extinct as a native plant in the upper part of the Thames estuary. Typically the above species all occur amongst or at the edge of grass bordering the road surface and so are less likely to be found nearer London where edges are generally concreted, but Mr Kitchener's one plant of *Juncus gerardi* was at the limit of our area wedged between two kerbstones of the A21 Sevenoaks by-pass. Can none of these be found by major roads in other parts of our area? Why are some common saltmarsh plants like *Glaux* and *Triglochin maritima* not found on these inland sites?

As usual I received a long and very varied list of plants from J. R. Palmer. He found a new colony of that rare orchid *Epipactis phyllanthes* in the Swanscombe area (57T84) numbering 27 spikes. On bluffs at Knockhall south of Mounts Road the alien grass *Cynosurus echinatus* was abundant together with one plant of *Oenothera rubricaulis* which was thinly scattered about the neighbourhood. A field near Wood Street (56T28) had one *Chrysanthemum segetum* which has become very scarce in the London area; other fields nearby which had been manured with some unidentified material had *Abutilon theophrasti, Datura stramonium* and its var. *tatula, Medicago polymorpha, Chenopodium probstii* and other aliens in their weed flora. Sewage sludge is known to be the manure used in fields on Dartford Marshes which produced *Solanum scabrum. S. americanum* was found as two plants in a situation near Erith (57T08) which indicates their origin from soybean waste. At the very edge of our area at Perry Street (67T22) Mr Palmer found a very large well established colony of the tall scabious *Cephalaria gigantea.* In a churchyard at Chislehurst (46T28) he observed that seedlings of an alien rose *Rosa glauca* grow abundantly and reach a fair size where the closeness of headstones prevents the mower from getting to them. Still nearer London he explored Beckenham Place Park (37T60 and T80). The use of unsterilised peat as a soil dressing is the explanation for the occurrence in flower beds of *Juncus bulbosus, J. conglomeratus, Luzula multiflora, Spergularia rubra*, etc. Near New Beckenham station Mr Palmer saw a patch of *Campanula rapunculoides* on a wall. At St Paul's church were *Erophila verna* and other spring annuals.

Early in 1982 Mrs J. Pitt and A. Watson visited an area near the River Cray above Bexley (47T82) which turned out to be ancient alder woodland with abundant *Carex pendula* and some previously unrecorded *C. paniculata*. Mrs Pitt was able to visit a meadow north of Keston Common (46T04) which has been acquired by the London Borough of Bromley, though at the time of writing it is not yet accessible to the public. As well as more uncommon sedges (*C. nigra, C. pallescens*) this site has lots of *Caltha* and *Genista tinctoria*. By a lake in the same property *Leucojum aestivum* is naturalised. Her friend Mrs J. Weightman was taken by an obliging railwayman to the cutting alongside Pett's Wood (45T48) where there are *Dactylorchis fuchsii, D. praetermissa* and the hybrid between them; these orchids can be seen, but not of course identified from passing trains, south of the track where there is a small sandy cliff set well back from the edge.

Good material of *Carex muricata* was collected at a surprising locality in the middle of Bromley (46T08) by Kathryn Kavanagh. Another sedge, *C. ovalis*, was the most unusual of the 115 species of vascular plants found in Brockley Cemetery (37T64) on 17 May by one of the excursions following the annual general meeting of the Botanical Society of the British Isles. The same party visited Camberwell Old Cemetery (37T44) which produced 109 species, including *Armeria maritima* which here must have been planted originally. This cemetery is right on the old county boundary and I think its records may belong in the next section.

V.C. 17, Surrey

Few of the many records received from this part of our area have been striking novelties of the kind these compilations seize upon, a description which certainly fits the Mediterranean annual *Centranthus calcitrapa*, reported independently from the churchyard of St Ann's, Kew (17T86) by Mrs E. Norman and J. B. Latham. Mrs Norman's plant was determined by E. J. Clement. Mr Latham's did not get correctly named until he found more of it in Kew Gardens, with a label. The seed of the species is well adapted for carriage by the wind and I have no doubt that he found the origin of the churchyard population, which from his notes evidently got through two generations in 1982. The only previous British records of *Centranthus calcitrapa* are all from London; on a well at Eltham, then a village in Kent, it persisted for a couple of centuries until the wall was demolished in about 1890. Mrs Norman also supplied an interesting list from the Wandsworth nurseries, which are near Merton (26T26), including *Barbarea verna*, abundant *B. intermedia* and *Lathyrus nissolia*. Mr Latham's next best Surrey record was of *Onopordon acanthium*, two large plants from near Vauxhall station (37T08).

Another long list of Surrey plants was supplied by R. B. Hastings, all from the area near the Thames from Ham to Barnes. At the Barn Elms Reservoir site (27T26) they include *Cerastium semidecandrum* and *Ornithopus perpusillus*. The Lonsdale Road reservoir site (27T06), which is now managed as a nature park, had a clump of *Rumex obstusifolius* × *patientia* which Lousley omitted from his *Flora of Surrey* (1976) although he was aware of previous occurrences of this hybrid from the same part of the county. By the river at Mortlake (27T06) Mr Hastings found *Rorippa amphibia* × *islandica*. On Kew Green (17T86), as well as *Trifolium glomeratum* which is no longer in the exact locality where it was re-discovered in 1977, that being covered in concrete, Mr Hastings found three plants of the *Cerastium* mentioned and one of *Stellaria pallida*. His best finds from Ham River Lands are a group of plants of *Vicia lutea*, no doubt casual here (17T62), many plants of the same *Rumex* hybrid (17T62) and one white-flowered *Verbascum blattaria*.

B. R. Radcliffe's discovery of the hybrid rush *Juncus acutiflorus* × *articulatus* on Bookham Common (15T26) is reported elsewhere in this issue; other interesting observations from him are the confirmed presence of *Rosa sherardii* on Banstead Downs (26T40) at our meeting there in August, its only extant locality in our area, and the hybrid St John's wort *Hypericum* × *desetangsii* growing at the point of contact of its parents *H. perforatum* and *H. maculatum* on Banstead Heath (25T44). Mrs S. Luce found *Digitaria sanguinalis* and *Setaria viridis* in a flower-bed in Upper Richmond Road (27T44) and two well-established clumps of *Peliphyllum peltatum* by the Thames below Walton Bridge (16T06) also noticed in 1981 by R. A. Boniface. Miss E. M. Hillman's records include lists from West Norwood Cemetery (mostly 37T22) and Worms Heath (35T66 etc.). In the latter place she was shown a plant which the late Mr Clarke called *Campanula rapunculus* but there seems to be good reason for supposing that it was the equally rare *C. patula*.

V.C. 18, South Essex

Another of the B.S.B.I. parties in May visited the churchyard of St Mary Magdelene, East Ham (48T22) which is run as a nature reserve. To the list published at about the same date by the Passmore Edwards Museum they made a dozen additions, including *Arabidopsis* and *Anchusa arvensis*. Miss Hillman went to Ongar (50T42) and found *Lathyrus latifolius, L. sylvestris* and *L. tuberosus* all climbing the same chain-link fence, which suggests that someone has been planting these vetches for a reason I cannot infer. B. L. Coombes again sent many notes of his own observations, including *Orchis mascula, Carex pseudocyperus, Sanicula europaea* and *Scutellaria galericulata* in Highfield Wood (69T22) at the edge of our area, *Galeopsis bifida* by a field at Navestock (59T44), *Scirpus sylvaticus* and *Equisetum fluviatile* filling a silted pond at Frieze Hall (59T44) and *Ranunculus lingua* and *Nymphaea alba* in a farm pond (59T66). He identified as *Polystichum aculeatum* a fern collected by Mrs Brooke at Stapleford Tawney (59T04).

V.C. 19, North Essex

The many records supplied by Mrs A. M. Boucher include a few from the Essex side of the R. Lea (30T88). In the gravel pit beyond Fieldes Lock she found *Trifolium striatum*, our first record from this part of our area, and in nearby waste ground *Aquilegia vulgaris, Euphorbia cyparissias, Hesperis matronalis* and *Senecio cineraria* which must all be of garden origin, though no recent dumping of garden or other refuse was evident. A garden at Dobb's Weir had *Chaenorrhinum minus* which is rare in gardens except on chalk.

V.C. 20, Hertfordshire

Mrs Boucher was privileged to visit, with T. J. James of the North Herts Museums at Baldock, the private grounds of Rye House power station (30T88), where a 20-year old fly ash tip is managed as an unofficial nature reserve by a member of the Central Electricity Generating Board staff. The 120 plants seen here include *Dactylorchis incarnata, D. fuchsii*, hybrids between them and many other uncommon species characteristic of wet places, e.g. *Myriophyllum verticillatum, Valeriana officinalis, Alisma lanceolatum, Carex paniculata* and the alien *Crassula helmsii*. The *Myriophyllum* is well known from Lea Valley gravel pits but she also found it, with *Menyanthes*, in Brickendon Green pond (30T26). Mrs Boucher saw *Dactylorchis incarnata* and *D. fuchsii* together in the valley near Cheshunt (30T62); two plants of the former had the bright red flowers which are the distinguishing feature of the subsp. *c.occinea*. By the river Mimram at the northern limit of our area (21T62) she found the now rare grass *Catabrosa aquatica* and in a lagoon at Rye Meads sewage works (31T80) was *Iris sibirica*, a popular plant for the margins of garden ponds, here far from any public access. She also communicated to me the discovery by A. Wood of a single bee orchid *Ophrys apifera* in Cheshunt Marshes (30T60?).

The discovery of *Fritillaria meleagris* near Northaw (20T**) by D.A. Wells in 1973 has not been reported previously. A small group of plants was growing in old pasture in a damp hollow on London Clay.

V.C. 21, Middlesex

Two rare clovers have been found in Middlesex after a long interval. The first record of *Trifolium glomeratum* since 1871 was made by C. D. Preston who found a single plant in Hampton Court Park (16T68) in 1981, in 1982 a further small group of plants was found in a different part of the park (also 16T68) by R. B. Hastings. Mr Hastings later discovered a fair quantity of *T. scabrum* near the Thames (still 16T68) in what appears to be the same locality as the 1892 specimen collected by C. A. Wright, and supplied detailed localities for many other rarities in this area (includes part of 16T66), among them *T. striatum, T. subterraneum,* *Moenchia erecta, Salvia horminoides, Poterium sanguisorba* and one plant of *Artemisia absinthium*. His record of *Campanula poscharskyana,* not previously noted as a naturalised alien in Middlesex, is the best, referring to a patch of 5×6 feet on the river wall below Barnes Bridge (27T06).

This Dalmatian *Campanula* species is common in cultivation and easily established on walls. By chance it appears also in the Middlesex records of both J. R. Palmer and J. B. Latham. Mr Palmer reports it as abundant at St Michael's Church in Belgravia (27T88?) and on pavements in Dilke Street, Chelsea (27T66). Also at the church was an 18-inch seedling of *Persea gratissima* growing from a wasted avocado pear lying on the ground. The many other unexpected aliens in his list include good patches of *Polygonum capitatum* on a pavement near Chelsea Embankment (27T66), *Tradescantia fluminensis* below street level on ruined steps near Vauxhall Bridge (27T88), seedlings of *Begonia rex* alongside the approach to St Saviour's Church, Walton Street (27T68) and a strong seedling of *Lavandula angustifolia* in a pavement crack in Oakley Gardens (27T66). Slightly less unfamiliar names are those of *Hebe×franciscana* and *Cotoneaster lindleyi,* seedlings near Hyde Park Corner (27T88), *Pteris cretica* growing on steps in a ruined basement in Chesham Street and on a brick wall close to Victoria Station (27T88) and *Solanum capsicastrum* in a gutter in Halkin Place (27T88) and elsewhere. I can confirm that the *Smyrnium* he saw almost under Grosvenor Bridge (27T86) is *S. olusatrum.*

Mr Latham's *Campanula poscharskyana* is on an old church wall in Inkerman Terrace, W.8. His other records include *Arum maculatum, Sherardia* and *Knautia arvensis* in Brompton Cemetery (27T46), a variety of plants in Bishop's Park, Fulham (27T26 and T46) such as *Valeriana officinalis* well naturalised, *Scrophularia aquatica, Phytolacca acinosa* behind a derelict conservatory and *Achillea tanacetifolia* rooted on its wall, and many plants from Kensal Green Cemetery (28T22) such as *Poterium polygamum, Digitaria sanguinalis* on a wall in the rose-garden and *Thalictrum minus.* He conducted the B.S.B.I. party in May which visited this cemetery and was able to demonstrate *Lamium hybridum* and many of the species mentioned a year ago (Burton 1982: 106) as having been found by him. *Carex divulsa* and the hawkweed *Hieracium lepidulum* were among other plants found on that occasion.

Mrs M. V. Marsden again produced many interesting records. The best perhaps is of *Dactylorchis maculata*, the heath spotted orchid on Stanmore Common (19T44) where it was previously seen in about 1900. In the grounds of the Grimsdyke Hotel (19T42) she found a large population of *Erophila verna* on gravel and more or less naturalised *Anemone ranunculoides*. Fields at Harrow Weald (19T42), used by a riding stable, produced *Scirpus setaceus* and *Montia fontana*. In Brent Park (28T48) she collected a hawkweed which I identified as *Hieracium subamplifolium;* this species occurs naturally in an area of west England and adjacent South Wales and has been seen once before in the London area, presumably as a chance introduction, at Walthamstow Reservoirs in 1954. Mrs Marsden also passed on to me news of the discovery by Miss D. Thompson of *Brunnera macrophylla* established on a playing field at Harrow Weald (19T42), the first time this persistent perennial alien plant with flowers like forget-me-nots, but much broader leaves, has been observed growing wild in Middlesex. This was identified by D. H. Kent, who has passed on a number of other scattered observations from the vice-county, including the summer-fertile variety *serotinum* of *Equisetum telmateia* found by I. M. Evans in the grounds of the Royal National Orthopaedic Hospital (19T64), P. J. Cribb's *Thalictrum flavum* near the railway at Staines (07T20) and the alien nipplewort *Lapsana intermedia* discovered by R. C. Palmer growing in some quantity on the Isle of Dogs (37T..).

Finally I must mention some contributions from D. Bevan, starting with *Rumex maritimus* which he found growing round the base of a disused concrete sewage container at Bounds Green (29T80). The hybrid of *Sorbus aria* and *S. aucuparia* which he found at the edge of Coldfall Wood (29T60) had reached some ten feet and inside the wood was a slightly larger individual of *S. torminalis. Amaranthus hybridus* and *A. albus* growing together on a pavement in Muswell Hill (28T88) were a curious discovery. He showed many unusual plants to our meeting on July 28th on the course of a former railway between Highgate and Alexandra Park, now a 'nature park', including *Anthemis arvensis* and *Fagopyrum esculentum* which might have been introduced in a 'conservation mixture' of seed used by the warden in one small area of embankment. Later he reported a large patch of *Rubus odoratus* in the Muswell Hill section of this feature.

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Book Review

Parasitic Protozoa in British Wild Animals. By J. R. Baker. Institute of Terrestrial Ecology, Cambridge. 1982. 24 pp. £1.70

It is unclear for whom this booklet was intended. The author's interest in blood-borne parasites is made abundantly clear since, in 12 pages of text, excluding the three pages of introduction and eight pages of appendices, six are devoted to the blood-borne parasites of birds. In the introduction Dr Baker discusses the confused usage of the terms parasitism, commensalism, symbiosis and mutualism that exists in the literature, but unfortunately fails to define his usage of these terms. Although a booklet of this nature cannot hope to be comprehensive, it should be balanced in approach and include some of the more common cases of protozoan parasitism. For example the section on fish parasites does not mention *Ichthyopthirius,* the ciliate responsible for white spot disease. The section on reptiles and amphibians is even more terse (4 lines and 1 figure of a Mexican haemogregarine), although in teaching classes the common British frog *Rana temporaria* is used as a source of opalinids and other intestinal protozoa.

The 'Further Reading List' omits Mackinnon and Hawes (1961) and Grell (1973), the former containing an extensive host/parasite index and the latter being an excellent text on the biology of protozoa. The recommended book by Farmer (1980) is generally regarded as being out of date, despite its recent publication, and contains many inaccuracies.

It is unfortunate that this publication has not maintained the very high standard of the series set by Belcher and Swale (1976,1979) and Page (1981).

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D. McL. Roberts

The Golden Hamster in the London Area

by CHRISTOPHER LEVER*

In late 1981 a number of golden hamsters *Mesocricetus auratus*, first introduced to this country as pets from Syria in the 1930s, became established (presumably having escaped or been released from captivity) in council houses, garden allotments and toolsheds on a housing estate at Hook Walk, Burnt Oak, in the north-west London borough of Barnet. They successfully survived the hard winter of 1981-82 in hibernation, and by the early autumn of the latter year some 200 had been killed by private individuals, suggesting a population running into four figures.

These animals, which have previously become temporarily established elsewhere in England (Rowe 1960, 1968; Lever 1977), e.g. at Bath, Finchley (Middlesex), Barrow-in-Furness, Bootle, Manchester and Bury St Edmunds (Suffolk), are a potential economic, ecological and health hazard. They are best controlled by gassing or trapping or by flooding their burrows. Poisoning is ineffective for two reasons; firstly because the animals hoard much more food than they require and are thus unlikely to ingest lethal concentrations, and secondly because their habit of storing food in their cheek-pouches gives the poison time to react and be detected and rejected before being swallowed.

The Prevention of Damage by Pests Act 1949, which delimits the statutory duty of Environmental Health Departments, requires local authorities to keep their areas free only from rats and mice. Because these animals are specified in the body of the Act (which has not so far been amended) rather than in a Schedule, it would appear impossible to extend the provisions of the Act to other species by Order.

This is clearly a loophole which should have been plugged by the Wildlife and Countryside Act 1981, and it is to be hoped that the government will now take appropriate action. Meanwhile, it should be pointed out that it would be an offence under Section 14 (1) of the 1981 Act deliberately to release hamsters (or other alien species) into the wild or negligently to allow them to escape.

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Amphibia and Reptilia in the London Area, 1981 and 1982

by Peter W. King*

AMPHIBIA

Great crested newt *Triturus cristatus*

MIDDX. Uxbridge Technical College, a well established colony (TQ063847).

Smooth newt *Triturus vulgaris*

HERTS. Spawns in many garden ponds in Totteridge and High Barnet areas. Often seen in garden of 27 Southway (TQ255937). Nearest breeding pond to there is at 49 Southway.

KENT. 206 Green Lane, Eltham (TQ435729). One seen in garden. Adults and tadpoles in garden pond, Hayes Way, Beckenham (TQ389683).

MIDDX. Breeds in Uxbridge Common Pond. April 1982, six half-grown specimens under stone in garden of 23 North Common Road, nearby. Six in a garden pond, Dewsbury Road, Dollis Hill, N.W.10, in 1981. The Hill, public garden near Spaniards Road, Hampstead, some tens in an ornamental pond, 1981. Park Wood, Ruislip, June 1982 (TQ098890). Garden ponds in South Harrow (TQ137865) and Greenford (TQ142855). Pond in a nature reserve, Perivale, July 1982 (TQ160836). Uxbridge Technical College, large colony (TQ063847).

SURREY. Bookham Common, not seen very often but probably common.

Palmate newt *Triturus helveticus*

MIDDX. Ten in a garden pond, Heybridge Avenue, Pinner, 7 June 1981.

Common toad *Bufo bufo*

ESSEX. 23 Lytton Road, Leytonstone E.11. One found hibernating on 1 February 1981. several seen in the very small pondless garden in Summer 1981. One very small in garden of 21 Severn Drive, Upminster (TQ572882), on 23 June 1981.

HERTS. Spawns in garden pond of 21 Southway (TQ255938). Fairly often seen in gardens in Totteridge and High Barnet areas. Frequent in garden of 27 Southway (TQ255937). One female with spawn found on 1 February 1981 (very early!) in Darlands Lake (TQ245934). Bentley Priory nature reserve, Stanmore, 6 September 1981. Cheshunt gravel pits, path by a marsh (TL3603), one male seen on 11 July 1981.

KENT. Keston Lake, Holwood Park Avenue, Keston, has a breeding colony. Regularly seen on allotments, Bourne Vale, Hayes (TQ403668).

MIDDX. Alexandra Park (TQ3090). Hampstead Heath, common over most of the heath. One male seen, garden of 7 Aberdeen Park, Islington, N5 (TQ321856), 8 April 1981. Present all summer 1982 in a garden at Eastcote with a well established pond (TQ112878) and also all summer 1982 at Greenford in a garden with pond (TQ142855).

SURREY. Pinewood Court, 23 Clarence Avenue, S.W.4. Two in amplexus in a car port on 25 March 1981. Taken in by Peter Holland and allowed to spawn in a fish-tank, then released. Spawn grew up to young toad state in captivity. Twenty-seven toadlets were liberated on Wimbledon Common and nine toadlets released in the garden of Pinewood Court. 75 Dupont Road, S.W.20 (TQ238693), usually present. Toadspawn seen in Queensmere, Wimbledon Common. Mitcham Common, scrub and long grass around large pond, frequently seen. Footpath through Croydon Cemetery, just east of Mitcham

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Common; dozens seen crossing on a wet evening March 1981. Shirley Park Golf Course, Shirley, one seen August 1981. Bookham Common, seen frequently over much of the common.

COMMON FROG *Rana temporaria*

ESSEX. Walthamstow Marshes, North Marsh (TQ3587), small amount of frogspawn 28 March 1981.

HERTS. Abundant in the garden of 96 Forbes Avenue, Potters Bar (TL265010). Extreme dates 8 May to 11 October 1981 and 12 February to 23 October 1982. Increasing in abundance in garden of 27 Southway, Totteridge, N.20. (TQ255937). First seen here in 1977 (one), one in 1978, three sightings in 1979, the latest on 13 December, six sightings in 1980, ten in 1981 and 19 in 1982. The garden here is small and there is no pond. Nearest possible breeding ponds are at 21 and 49 Southway. Mr D. Griffith also writes that he has studied all the accessible ponds out of those frog ponds studied by Savage (1961) in Totteridge about 45 years ago, but that he found no frogs or spawn in any of them. Many, e.g. Totteridge Long Pond (TQ235941) are now very polluted. Nevertheless, the common frog is very common in the Totteridge and High Barnet areas still, breeding in garden ponds though. Also in Totteridge one minute frog was seen near the garden (TQ254937) and another minute frog was found in the churchyard (TQ248942). Darlands Lake nature reserve (TQ245934) 21 March 1981, four and five spawn clumps respectively in two ponds, 20 September 1981, one adult.

KENT. 206 Green Lane, Eltham, S.E.9 (TQ435729). Two frogs present for most of 1981, first spawn in pond 13 March but no froglets reached stage of leaving pond. Another frog dead, disembowelled. Yet another was killed by a cat next door. In 1982 one frog was killed and eaten by a cat on 13 February but spawn was seen on 13 March and a tiny frog was seen on 11 July. Three adult frogs were present when the pond was drained on 18 July and were still present in the pond in September. John Mitchell knows of two gardens close by 206 Green Lane where frogs are also present and he considers their numbers to be increasing. Broad Lawn (TQ433730), up to 30 present in a small pond. Lots of spawn every year. Rookery estate lands, Bromley Common (TQ415665), seen frequently, breed in Rookery Lake (TQ415670). Also frequent at the allotments, Bourne Vale, Hayes (TQ403668), and spawn and frogs are general in garden ponds in Hayes, Beckenham and West Wickham.

MIDDX. Alexandra Park (TQ3090) common both years. 7 Hodford Road, Golders Green, N.W. 11 (TQ250868), several spawn every year in a garden pond. 112 Corringway, Ealing, W.5, two adults in summer 1981 in lily pond and on 24 March 1982 spawn, tadpoles and one frog found in the pond. Uxbridge Common pond contained many breeding frogs in Spring 1982 and in the large overgrown garden of 23 North Common Road, just opposite, frogs are often seen. Two yearlings found under a stone in April 1982. At 83 Wentworth Avenue, Finchley, N.3 (TQ256915), the first spawn in 1981 was seen on 9 March, when there were 18 adult frogs in two small ponds. Dewsbury Road, Dollis Hill, N.W.10, two in pond 1981. Hampstead Heath, less common than toads. Present in all warmer months in garden ponds at Eastcote (TQ112878), South Harrow (TQ137865), and Harrow (TQ145875), during 1982. Greenford (TQ142855), found in garden pond from June to September 1982. Early March 1981, one in garden of 54 Whitehall Park Road, Chiswick, W.4.

SURREY. 20 to 30 breed each year in the garden of 118 College Road, Dulwich, S.E.21. Common in gardens of houses in Welcomes Road, Kenley, and often seen squashed on the road. One seen in a greenhouse at 102 Burdon Lane, Cheam, several times in August 1981. Garden at 75 Dupont Road, Raynes Park, S.W.20 (TQ288693), one adult seen 11 February 1982. Early March 1982, abundant spawn seen in ponds and temporary standing water all over Wimbledon Common (TQ2271 to 2273, 2371 to 2373) and also in Scio Pond, Putney Heath (TQ2273). Streatham Common, the Rookery, spawn in pond in ornamental garden every year: 30 adults and abundant spawn in pond on 6 March 1982. (TQ310708). Garden of 142 Harborough Road, Streatham, S.W.16 (TQ307717), one adult each summer. Six adults in garden of 65 Sunnyhill Road, Streatham, S.W.16. (TQ304718) on 4 February 1982. One seen in garden in Heybridge Avenue, S.W.16 (TQ309707) in August 1982. One disturbed from ground-covering vegetation in old orchard, 128/130 Sunnyhill Road, Streatham, S.W.16 (TQ306717), on 31 October 1982. Breeds in pond on Tooting Bec Common every year. Mitcham Common, often seen near large pond in dense wet grassland and scrub. Bookham Common, sometimes seen in wet weather near ponds and in low lying areas prone to flooding. Spawns in most ponds.

REPTILIA

Grass snake *Natrix natrix*

HERTS. Darlands Lake nature reserve, one seen 9 August 1981 (TQ245934).

KENT. Hayes Common (TQ413649) seldom seen but one photographed on 14 March 1981: exceptionally early, but March 1981 was very mild.

MIDDX. Late record for 1979, one from Hendon Wood Lane. Greenford, summer 1982, found in numbers at a garden pond (TQ142855). Stanmore, a garden backing on to a golf course (TQ169913), seen on odd days in summer 1982.

SURREY. A two-foot-long specimen was found in a hole in a wall on the Tulse Hill Estate, S.W.2 (TQ306740). It was identified by the R.S.P.C.A. and reported in the *South London Press* on 6 August 1982. Bookham Common, seen occasionally both years. I found a cast-off skin on 14 August 1981 in an area of felled logs on the common.

Adder *Vipera berus*

KENT. Has been seen in recent years on a heathy part of Hayes Common (TQ413648) but was not seen in 1981 or 1982.

SURREY. Banstead Heath, one seen 26 July 1981 (TQ228552), another seen 5 September 1981 (TQ233554). This population seems to be declining.

Common lizard *Lacerta vivipara*

KENT. Hayes Common (TQ405652), abundant in 1981. Keston Common (TQ4264), abundant in 1981, first seen on 17 April, two basking at TQ415648.

SURREY. Abundant on the more open areas of the southern half of Bookham Common. Adults not very often seen, but numerous young of the year always found from late August onwards.

Sand lizard *Lacerta agilis?*

HERTS. Mrs M. Evans reports these from her garden in Totteridge near The Pastures, off Totteridge Lane (TQ251940). They are commonly seen on an old wall and breed in the compost heap. She seems certain of the identification.

Lizard *Lacerta* sp.

HERTS. Late record for 1977, Brick Lane, Arkley.

Slow worm *Anguis fragilis*

HERTS. Garden of Mrs M. Evans, Totteridge (TQ251940). July 1981, one seen on a golf course near The Pastures, Totteridge (TQ249944). Also known from a railway embankment at Totteridge (TQ259947).

MIDDX. Two on a builder's rubble dump, Mill Hill, 1981. Seen every summer in the garden of 83 Wentworth Avenue, Finchley, N.3 (TQ253912) and on a railway embankment, also in Finchley.

SURREY. Richard Kearton reserve, Warlingham, in 1981. Welcomes Road, Kenley, two road victims in 1981. Bookham Common, seen occasionally, near the station. I caught one pregnant female basking on an elm log here, in Station Copse, on 10 July 1981.

Acknowledgements

I wish to thank all those members who have submitted records in the past two years: Caroline Black, Neil Bowman, John Bratton, Don Burchfield, John Cresswell, Gordon Dickerson, Thomas Gittings, D. Griffith, Ella Hillman, Peter Holland, Keith Hyatt, Ron Kettle, Jon King, Clifford Millner, John Mitchell, Hugh Nelson, Bryan Radcliffe, Rosemary Rawldon, Kevin and Vincent Reidy, Ray Softly, Derek Warren, and Martin Wills.

If anyone has been omitted from this list, would they please accept my apologies for the oversight.

REFERENCE

SAVAGE, R. M. 1961. *The ecology and life history of the common frog* (Rana temporaria temporaria). Pitman. London.

Book Review

Guernsey's Earliest Flora: Flora Sarniensis. By Joshua Gosselin, with an introduction and commentaries by David McClintock. Ray Society, London. 1983 [1982]. 210 pp. £14.

Joshua Gosselin (1739-1813) was born in Guernsey of one of the island's leading families, and although visiting various parts of England spent most of his life on the island, becoming a Greffier or Deputy Greffier (Clerk of the Royal Court and Keeper of the Public Records, a Crown Appointment), a post that he held for over 30 years. He was also an officer of the island's militia for nearly 44 years, and Colonel of his regiment for 12 years. Apparently naturally gifted, he was an antiquarian, artist and naturalist, and began in 1788 a flora of the island under the title *Flora Sarniensis, or the Genera of Guernsey Plants.* This he arranged in the order and nomenclature of the first edition of William Hudson's *Flora Anglica;* somewhat later he commenced the compilation of a herbarium of the plants of the island. An abridged version of the *Flora Sarniensis,* with all localities and page references to Hudson's *Flora,* was published as a supplement to W. Berry's *History of the Island of Guernsey* (1815).

The MS drafts of the *Flora Sarniensis* and the herbarium apparently disappeared shortly after Gosselin's death though the latter was bequeathed to his granddaughter, Mary Carey, who died in 1823 at the early age of 26. The first draft of the MS *Flora* reappeared at an auction in Dublin in 1950, was sold with other botanical MSS, and is now in private hands. The second draft, virtually identical with the first, was presented to the Guille-Allès Library at St Peter Port in 1919. Gosselin's herbarium, after being missing for nearly 80 years, was refound in 1900 in the possession of Edgar Dupury, a Guernsey chemist. Dupury died in 1901 and the collection passed to his daughter. Later it came into the hands of a Miss Marquand, who *c.*1946 presented it to La Société Guernesiaise as 'A collection of dried plants, collector unknown'. About 1970 the herbarium was identified as that made by Gosselin.

With the bringing together of the MSS and herbarium, David McClintock, who has long been interested in the flora of Guernsey, was able to revise and edit the account of over 600 species which comprise the *Flora Sarniensis,* and with the aid of the herbarium and other material provided much additional historical data. Thus, it is now shown that Gosselin was responsible for 500+ first records for the island, and also that his herbarium provided the earliest evidence of the occurrence in the British Isles of a number of species, including *Lotus subbiflorus, L. angustissimus, Epilobium lanceolatum, Centaurium pulchellum, Centaurea aspera, Orchis laxiflora* and *Lagurus ovatus,* as well as for such critical species as *Trifolium occidentale, Polygonum rurivagum, Bromus ferronii* and *B. thominii.*

The book, which includes a sketch map of Guernsey showing the localities referred to by Gosselin *c.*1790, is a valuable contribution to the historical floristics of the Channel Islands.

D. H. KENT

A Review of the Lepidoptera of the London Area for 1981 and 1982

by C. W. Plant*

Introduction

The now traditional method of reviewing the area by vice-counties has been maintained for the larger moths. The inclusion of a section on the Microlepidoptera in the review however is a relatively new idea; accordingly there are few records, particularly for the less well studied families. For the time being therefore, I have found it convenient to present this as a species by species account in a separate section. It is hoped however that sufficient interest in the 'micros' will be aroused to stimulate the flow of records in my direction in time for the review of 1983-84!

The butterflies too have been dealt with separately, discussing all the reported species in order for the two-year period. This has been done with the intention of stimulating further records for inclusion in the proposed 'Atlas' of London's butterflies (see *Lond. Nat.* **60**: 104). In subsequent years it is likely that only noteworthy species and interesting sightings will be mentioned here, as was the case in the late Baron de Worms' reviews.

Whilst butterfly records have reached me in quantity, particularly for 1982 which was an excellent year for all Lepidoptera in our area, there have been alarmingly few moth records. May I therefore seize this opportunity to remind readers that all Lepidoptera records are called for. This is equally true for past records as well as for those intended for inclusion in the next biennial review. All reliable records are being mapped onto a five by five kilometre grid with a view to possible publication in due course. The 'ideal list', if such a beast exists, will be numbered and presented in the order given in Bradley and Fletcher (1979). The nomenclature adopted by these authors will also be used. Each species will be accompanied by the date(s) and a six-figure grid-reference, supporting evidence where appropriate (for example the name of a referee, a photograph, or your own qualifications and experience if you are not known to me, and a note saying where the voucher specimen may be examined if necessary). Lengthy lists will also have the more noteworthy species highlighted in some way, to prevent me from getting eyestrain by poring over large numbers of long lists in order to extract two or three records worthy of writing about. Records of the rarer species, where breeding is known at a particular site, will be accompanied by a note on what degree, if any, of confidentiality the observer feels to be desirable. I will, however, accept lists that fall short of this ideal, particularly if they can reach me during the December of the year to which they refer.

BUTTERFLIES

The launching of the Butterfly Atlas Project during 1982 has resulted in a tremendous number of records being submitted for that year, particularly of the commoner species. I am particularly grateful to the very many people who have sent me notes of one or two species seen in their private back gardens; these are no less valuable than the lengthy lists received from more experienced entomologists, although there have obviously been a few problems with authentication of some of these records. Consequently however, it has proved impossible to acknowledge in this review all those people who submitted records to me. It is hoped that a full list of contributors will appear in the 'Butterfly Atlas' when it is eventually published.

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Concerning ourselves now with the records themselves, the small skipper *Thymelicus sylvestris* has been well reported in comparison with the easily confused Essex skipper *T. lineola*. The former was present in 127 tetrads in the L.N.H.S. area, compared to the latter's 64. Both were present in all areas other than Bucks., with Inner London records heralding from the Surrey Docks (TQ37T48) (D. Murdoch) for both species in both years, and Camley Street, NW1 (TQ38T02) (R. Softly) for *T. lineola* in 1981. The large skipper *Ochlodes venata* was reported over a wide area, but always in smaller numbers than the preceding two species. It was also present in the Surrey Docks (D. Murdoch). The dingy skipper *Erynnis tages* was seen on 26 May 1982 at Cole Green Way, Herts (TL21T80) (P. Waterton), whilst the grizzled skipper *Pyrgus malvae* was present at Downe, Kent (TQ46T20), and at Epsom Downs (TQ25T08?) where one entered the observer's house during June 1982 (M. J. Symes).

Perhaps the best butterfly of all, and a complete surprise too, was the single swallowtail *Papilio machaon* seen by David Murdoch at the Surrey Docks, TQ37T48, on 2 July 1982. It was watched for several seconds from a distance of five to thirty yards as it flew away. The wind was reported to be force three on the Beaufort Scale, but the direction was not given. The insect was not captured, so unfortunately we shall never know to which subspecies it belonged. Of course, the possibility that this was an escape cannot be ruled out; the British race, ssp. *britannicus* Seitz, is confined to the Fens of East Anglia, and had the Surrey Docks individual been of this type it would certainly be an escape. The continental form, ssp. *bigeneratus* Ver., which is larger and brighter than the British subspecies, has only been recorded six times in the L.N.H.S. area since the turn of the century, (Enfield, Middx. in 1911; Oxted and Richmond Park, Surrey, 1935; Orpington, Kent, 1945; Hayes, Middx. in 1949; and Bexleyheath, Kent in 1962).

That well known migrant butterfly the clouded yellow *Colias croceus* originates in southern Europe and North Africa. Seldom a year goes by without one or two reaching our shores, but good numbers are reserved for selected years only. There were no London records for 1982, but during 1981 a singleton was present at Rye Meads (TL31T80) on 22 August, where a previously unreported individual was also present on 26 August 1979 (A. Harris). Although the brimstone *Gonepteryx rhamni* is a resident, hibernating as an adult, the males do tend to wander far and wide as demonstrated by a fairly random distribution of reported sightings for 1981-82. Females however, were largely only reported from areas where the larval foodplants grow. A single male on 1 June 1981 at Lambeth Bridge (TQ37T08) is the only Inner London record (W. G. Teagle). Our three common white butterflies were very widespread and common during the two years under review. Reliable Inner London records are listed chronologically under each species:

Large white *Pieris brassicae*: 1 June 1981, Albert Embankment (TQ37T08) (W. G. Teagle); August 1981, Tooley Street, S.E.1 (TQ38T20) (M. J. Hammerson); 6 September 1981, Camley Street, N.W.1 (TQ28T82) (D. Rooum); 2 July 1982 Surrey Docks (D. Murdoch); 7 September 1982, Rotherhithe (TQ37T48) (W. G. Teagle); '1982' Holland Park (TQ27T48)) (T. Freed).

Small white *P. rapae*: 1 June 1981, Goding Street, S.E.11 (several), and Albert Embankment (one) (both TQ37T08) (W. G. Teagle); August 1981, Tooley Street, S.E.1 (M. J. Hammerson); '1982': Surrey Docks (TQ37T48 and 38T40) D. Murdoch); Waterloo Station (TQ37T08) (P. King); Holland Park (T. Freed).

Green-veined white *P. napi*: '1981', Kensington (TQ28T60); '1982': Surrey Docks — both tetrads — (D. Murdoch); Holland Park (T. Freed).

The records of the last species have an eastern bias, with Surrey and Middlesex being poorly represented.

The orange tip *Anthocharis cardamines* was reported from 118 tetrads during 1981-82, although the preponderance of males suggests that many casual observers are overlooking the other sex which lacks the bright orange markings on the upper surface of the front wings. Herts. and Middx. were the best counties with 36 and 29 tetrads respectively. There were no Inner London records.

Moving on now to the Lycaenidae, we have some interesting observations. The green hairstreak *Callophrys rubi* was seen in 1981 at Perivale Wood Nature Reserve (TQ18T62) and during 1981 at Grays Chalk Pit (TQ67T08) (D. Agasssiz), Hainault Forest (TQ49T62) (N. Nash), and in a scrub area north of Hillcrest Road, W.5. (TQ18T82) (P. Edwards). The more numerous purple hairstreak *Quercusia quercus* can usually be located wherever oaks grow in reasonable numbers. There were records for 34 sites during the two-year period, mainly in Herts, and South Essex (M.C. Foster, J. Hollingdale, P. Jupp, N. Nash, D. Prance, R. Softly, M. J. Wells, *et al.*). The much less common white-letter hairsteak *Strymonidia w-album* was reported only from Ongar Park Woods, South Essex (TL50T40) (N. Nash), although it seems likely that it should still be present elsewhere in spite of dutch elm disease. The small copper *Lycaena phlaeas* was reported from all the vice-counties in the L.N.H.S. area, and there is also a single Inner London record from Holland Park during 1982 (T. Freed). No migrant blues were reported for either year, but a probable new colony of one of the resident species, the small blue *Cupido minimus* was located in Middlesex at TQ17T--. The species was also present at Epsom Downs (TQ29T08?) during 1982, where the silver-studded blue *Plebejus argus* also occurs in some numbers (M. J. Symes). Inner London records of the common blue *Polyommatus icarus* herald from Arsenal Underground Station and Upper Tollington Park, N.4. (both TQ38T06) (J. Cotton); Camley Street, N.W.1 (D. Rooum); Surrey Docks (D. Murdoch); and Holland Park (T. Freed). Three reliable records of the chalk-hill blue *Lysandra coridon* have reached me, all for 1981. These are 20 June: Kent at TQ56T-- (R. M. Burton); 29 July: Surrey at TQ15T-- (J. M. Todd): and 16 August: Surrey at TQ35T-- (J. M. Todd). 1982 was a really excellent year for the holly blue *Celastrina argiolus* with scattered records from all areas except the small part of Buckinghamshire which lies within our boundary. A female was watched ovipositing on ivy *Hedera helix* in Kensington (TQ27T48) during August of that year (C. W. Wood), whilst other Inner London records are at Eaton Square (TQ27T88) (R. Bristow), Holland Park and the Surrey Docks.

If 1982 was good for *argiolus* then for the white admiral *Ladoga camilla* it was excellent. Five separate sites in Surrey produced adults during the year, and breeding has been confirmed for two of them (D. Prance, N. S. Kierman, P. King *et al.*). Four tetrads in Hertfordshire, TL30T-- and 31T--, produced adult insects too, with a peak count of five individuals at one of these sites on 18 July 1982 (P. Waterton). A single adult butterfly was seen in a garden at Totteridge, N.20 (TQ29T42) on two occasions. On the first of these, 19 July 1982, the butterfly was visiting the flowers of *Tradescantia*, whilst on the second occasion it (or another) was buy amongst brambles *Rubus fruticosus* agg. on 19 August 1982 (D. Griffith). Whilst this is a reliable record, the origin of the individual(s) is the subject of speculation, and the possibility of an escape cannot be ruled out. The purple emperor *Apatura iris* was reported from two sites only, at Ashtead and Bookham Commons. A male was seen feeding on dog excrement at the latter site on 12 July 1981 (Miss E. M. Hillman), and a female was doing likewise at Ashtead on 2 July 1982 (P. King). There are dozens of records of the red admiral *Vanessa atlanta* and the painted lady *Cynthia cardui*. These are regular migrants, and although they do breed in the London area they are apparently unable to survive the British winter. The large tortoiseshell *Nymphalis polychloros* is, it should be stated here for the benefit of less experienced observers, an extreme rarity in the L.N.H.S. area. I will not be able to accept records from inexperienced observers without photographic or other evidence. The species was recorded once only during the period under review: at Ranmore Common on 9 May 1982 (Harvey 1982). The Camberwell beauty *N. antiopa* is an uncommon migrant, particularly in the L.N.H.S. area. A weak and battered specimen was found inside the Jodrell

Laboratory at Kew Gardens (TQ17T68) on 25 August 1981, but died soon afterwards (D. Trewin, R. B. Hastings). Whilst there is always the possibility that it had escaped from nearby Syon Park Butterfly Centre, the condition of the insect and the date may suggest a wild individual. This record was preceded by another at South Croydon on 15 August 1981 (Smith 1981). The peacock *Inachis io* was reported once from Inner London during 1982, at Holland Park (T. Freed). An early record of this species, which hibernates as an adult, was obtained on 22 January by M. J. Wells, who saw one in flight at Ashford, Middlesex (TQ07T60). Many observers express surprise at recording the comma *Polygonia c-album* in the London area. Yet this is now a widespread insect with Inner London records in 1981 from Belgrave Square (TQ27T88) on 9 September (D. Withrington), and Southwark Street, S.E.1, (TQ38T20) on 5 August (M. J. Hammerson). The Surrey Docks and Holland Park were both forthcoming with this species in 1982.

It is always nice to receive records of the fritillaries, but would observers note that they are all to be considered as rarities in the L.N.H.S. area, other than at one or two known localities, and that all are rather tricky to identify if lacking in experience. Photography is an excellent way of convincing me of your identifications — it can be fun too! All the reliable fritillary records for 1981-82 are given here: Small pearl-bordered *Boloria selene* was recorded, surprisingly on the Conservation Plot at Kew Gardens, TQ17T66 on 26 August 1981 (D. Rooum). The origin of these insects is unknown — there were several of them. Pearl bordered *B.euphrosyne* was seen at Bookham (TQ15T24) on 29 March and 12 June 1981 (E. M. Hillman). Mrs J. M. Todd reports a dark green *Argynnis aglaja* at Ranmore Common, Surrey (TQ15T40) on 29 July 1981. This is a migrant species, as is the easily and often confused high brown *A. adippe*, for which there were no records for the period.

Amongst the Satyridae speckled wood *Pararge aegeria* was present in at least 111 tetrads during 1981-82. Kent (33 tetrads) and Surrey (34 tetrads) head the county list followed by Middlesex (19) and South Essex (15). Hertfordshire which has much suitable habitat produced only six records, whilst the rear was brought up by North Essex and Buckinghamshire with two tetrads each. This probably represents the true distribution of this species which is presently extending its range northwards. Not surprisingly there were no Inner London records.

The wall brown *Lasiommata megera* was equally well reported, however neither this nor the previous species are all that abundant in terms of population size. The records for the wall brown are largely in the north-east sector of the L.N.H.S. area. There are two positive sightings of the marbled white *Melanargia galathea* to report, both for 1981. Mr A. Merritt saw several at Box Hill (TQ15T62) on 18 July, while Mrs J. M. Todd saw the species at Ranmore Common (TQ15T40) on 29 of that month. During 1982 there was a fleeting glimpse of what may have been this species at Grays Chalk Pit, South Essex (TQ67T08) by the Warden (per D. Agassiz). Records of the gatekeeper *Pyronia tithonus* predominate in south-eastern Hertfordshire, North Essex, the western part of South Essex and Kent, with a few on the western perimeter of the area in Buckinghamshire, south-west Hertfordshire and Middlesex. The majority of Surrey and Middlesex however lack records. One interesting point of note is the colonisation of the Rye Meads area, Herts. by this species. There were two butterflies there on 8 June 1973 — the first record. During 1982 there were in excess of one hundred insects on the wing. The meadow brown *Maniola jurtina* on the other hand is a fairly cosmopolitan species. Inner London records involve Camley Street, N.W.1 (D. Rooum), Tooley Street, S.E.1 (M. J. Hammerson), Surrey Docks (D. Murdoch) and Kensington Gardens (TQ28T60) (R. Kettle). Apart from an apparent absence from most of Middlesex the small heath *Coenonympha pamphilus* was recorded in most areas, including Inner London at the Surrey Docks. The ringlet *Aphantopus hyperantus*, on the other hand, is recorded only from the outlying areas of Headley Heath (TQ15T84) and

Bookham Common (A. Merritt); Havering Park, Essex (TQ59T00) (N. Nash); Box Hill (TQ15T62) and Coulsdon (TQ35T06) (J. M. Todd); Stanmore Common (TQ19T42?) (R. V. Goulding); and Ashtead (TQ15T68) (A. S. Wheeler).

Finally, to complete this round up of London's butterflies for 1981/82 there are two records of the milkweed or monarch *Danaus plexippus*, one for each year. During 1981, between 10 and 15 August, about half a dozen individual butterflies were seen in ones and twos at various localities in Kew Gardens, and apparently had no difficulty in locating and laying eggs upon the larval foodplants growing there. All of these butterflies are known to have escaped from the Syon Park Butterfly Centre across the River at Brentford (J. L. S. Keesing). During 1982, a single adult insect was seen at Chislehurst, Kent, but no further details are available (see *Eltham and Kentish Times* newspaper for 15 July 1982).

MICROLEPIDOPTERA

A dismal few records of microlepidoptera have reached me for the two-year period under review, but at least there is quality amongst those that did. Perhaps the best was that of *Argyresthia trifasciata*, taken at actinic light on 3 June 1982 by Mr Ray Softly at his flat in Hampstead (TQ28T64). This is the first British record of the species, which was recognised by Rev. David Agassiz and later confirmed by J. D. Bradley. Mr Softly's trap is unusual in that it is situated some forty feet up on the south-facing balcony of his flat: this attracts such canopy feeders as *Microthrix similella*, which turned up on 7 July 1980, as well as the lower-flying species. The capture and ensuing events are given in more detail by Emmet (1982).

Mr Neil Nash has sent me an impressive list of 'micros' taken at light in Havering Park, South Essex (TQ59T02) during June and July 1982, all the determinations having been made or verified by Maitland Emmet. Of the 54 species listed, twelve were new records for the ten-kilometre square TQ59, and a further seven were post-1960 updates which serves to show the contribution to our knowledge of the distribution of the smaller moths that an amateur can make even in a county so well covered as Essex. Exactly half of the species recorded for Havering Park were tortricoids, and of these by far the most noteworthy was *Epinotia signatana*. This is a generally uncommon moth although it is perhaps increasing. Singletons were taken at two separate North Essex localities outside the L.N.H.S. area during 1982, bringing to six the total number of known Essex sites.

Amongst the other families represented there is an interesting momphid in the form of *Mompha nodicolella*. Emmet (1981) gives only one site in South Essex for this species: that at St Mary's Nature Reserve, East Ham, where a very large colony still persists. The only other Essex sites given number two, both in the northern vice-county, and both beyond the L.N.H.S. recording boundary. The Havering Park colony is apparently only a small one, but during 1982 I noticed very large numbers of imagines at Woodgrange Cemetery, Forest Gate (TQ48T04). It is possible that careful searching will reveal more colonies of this rather pretty little moth wherever large stands of rosebay *Chamaenerion angustifolium* occur. A further contribution made by Neil Nash was the record of *Lampronia fuscatella* from Romford, South Essex, during 1982. This is a new county record for this incurvariid moth, two of which were apparently in the trap together. Its larvae mine the stems of young birches *Betula* and it would therefore seem quite likely that the species is established in the area.

Mr Mark Hadley sent me a list of Lepidoptera from Kensal Green (TQ28T22) captured between 18 July and 29 September 1981, and this contains sixteen 'micros'. Five of these are tortricoids: *Agapeta hamana*, *Archips podana*, *Epiblema uddmanniana*, *E. foenella* and *Cydia pomonella*, all being fairly common species, even at Inner London sites. An equal number are pyralids.

namely *Evergestis forficalis, Eurrhypara hortulata, Pleuroptya ruralis, Hypsopygia costalis* and *Endotricha flammealis.*

Lt. Col. Maitland Emmet kindly gave me details of four species of particular interest which were recorded in the L.N.H.S. area. *Stigmella distinguenda* was recorded in Wanstead Park, South Essex (TQ48T06), during 1981. This is a birch feeder which is local and rather uncommon in the eastern portion of the L.N.H.S. area. Two imagines of *Tinea columbariella* were taken by G. S. Robinson on 23 June 1981 at Rainham, South Essex (TQ58T22?), providing another new county record. Details can be found in Robinson (1982). *Bedellia somnulentella* was recorded at St Mary's N.R., East Ham (TQ48T22), on 21 August 1981. This is generally an uncommon moth, but it can become locally abundant in some years. The larval pabulum is *Convolvulus* of which there is an abundance at St Mary's. The fourth species listed by Col. Emmet is *Parornix finitimella.* This may be an under-recorded moth, since in its early stages it is indistinguishable from *P. torquilella.* During 1981 it was apparently widespread and common in Epping Forest and the surrounding district.

As for my own observations for the period under review, various factors have resulted in these being limited to my home area of East Ham. At St Mary's N.R. there were some nice surprises, quite apart from *Bedellia somnulentella* which has already been mentioned. The locally common incurvariid *Nemophora fasciella* was taken once: the abundance of its larval papulum *Ballota nigra* apparently bears no relation to the distribution of the moth. Emmet (1981) records it from only four ten-kilometre squares in Essex, all in close proximity to the River Thames. *Oegoconia caradjai* has only recently been added to the British list (Agassiz 1982). Several specimens were taken during 1982 at the Nature Reserve, and I am grateful to David Agassiz for performing the determinations. The moth has also been recorded at Grays, Essex. *Mompha nodicolella* maintains its presence at this site, and its congener *M. subbistrigella* was also recorded in both 1981 and 1982. Of the tortricoids recorded, *Pandemis corylana* is more normally associated with woodland sites where its lavae are polyphagous on trees: the only 'woodland' at the Nature Reserve comprises sycamore *Acer pseudoplatanus* and some elm scrub *Ulmus* spp. A single specimen was taken at m.v. light on 3 August 1982. Whilst *Pammene aurantiana* is rare in Essex as a whole, the reverse would seem to be the case in the London area. Several moths were recorded in both years at the Nature Reserve and elsewhere in the metropolitan area of South Essex. The larvae mine the keys of sycamore, of which the area has no shortage. The best moth of the period for this ten-acre site however was undoubtedly the single *Eucosma pupillana*. This rather worn moth came to m.v. light on 2 August 1982, and was followed the next evening by a perfect specimen in my garden trap some short distance away to the north-east. A search of the local area for the foodplant *Artemisia absinthium*, produced several small patches along the River Roding from Barking Creek up to Barking itself.

Only sixty-nine 'micros' have been recorded at my new address in East Ham (TQ48T22) since moving in during May 1982. *Oegoconia caradjai* has already been mentioned: further specimens were taken here. The honour of 'best tortricoid' is shared by *E. pupillana* and *E. tripoliana*, of which single specimens came to the trap on one date in July and two dates in August. This is more normally a species associated with salt-marsh, where the larvae feed on *Aster tripolium.* In the same trap as the second *E. pupillana* was the best pyralid of the year, *Calamotropha paludella*. This species is quite uncommon and is a recent colonist in the Essex area. The larvae feed on *Typha latifolia*. Another very local moth recorded in my garden trap was the pyralid *Euzophera cinerosella*, and this is another one which feeds on *Artemisia absinthium.* These last four species, together with *Cucullia absinthii* (see review of larger moths), suggest that there is an as yet undiscovered 'good' area somewhere nearby along the River Roding, supporting a maritime flora and fauna. Other captures of interest made in my garden during 1982 include *Cataclysta lemnata* whose aquatic larvae survive on the duckweed *Lemna* in my garden pond; the now established migrant *Evergestis estimalis*, which was abundant; the apparently rarer *E. pallidata*, which was taken once only; *Pyla fusca*, which has adapted to feeding on *Erica* in urban gardens as well as on heathlands; and *Nomophila noctuella*. The last species, a migrant which also breeds successfully in most years, was recorded as far inland as Saffron Walden, North Essex (A. M. Emmet), and Welwyn, Hertfordshire (P. Waterton).

LARGER MOTHS

Inner London

On 26 July 1982 a single humming-bird hawk-moth *Macroglossum stellatarum* was observed feeding on *Buddleia* blossom in Little Venice, W.9 (28T62) (Lumley 1982).

Mr M. J. Hammerson has sent me a list of moths seen in London S.E.1 during 1981 and 1982. During the former year he had the cinnabar *Tyria jacobaeae* and the cabbage *Mamestra brassicae* in Southwark Street (38T20) and during October at South Bermondsey Station (37T48) he saw a garden tiger *Arctia caja*. During 1982 twelve larvae of the troublesome brown-tail *Euproctis chrysorrhoea* were collected from the gardens of Southwark Cathedral (38T20) where they were busy defoliating the hawthorn trees *Crataegus* sp. In July he had ten larvae of the cinnabar at Toppings Wharf, Tooley Street (38T20), and in the same tetrad he also found garden carpet *Xanthorhoe fluctuata* on 16 July. To complete Mr Hammerson's records for the Inner London area, he reports a freshly emerged marbled beauty *Cryphia domestica* in Davies Street, W.1 (28T80) on 27 July 1982.

Sixty-nine 'macros' were taken at light by Mr M. Hadley between 18 July and 20 September 1981 at Kensal Green (28T22), just within the Inner London boundary. The poplar hawk *Laothoe populi* and privet hawk *Sphinx ligustri* were both represented. Nineteen geometers incuded the chevron *Eulithis testata*, July highflier *Hydriomena furcata*, shaded broad bar *Scotopteryx chenopodiata*, peppered *Biston betularia*, small rivulet *Perizoma alchemillata* and four 'pugs': toadflax *Eupithecia linariata*, lime-speck *E. centaureata*, bordered *E. succentaureata* and double striped *Gymnoscelis rufifasciata*. Exactly forty noctuids were on his list, including the black rustic *Aporophyla nigra*. The remaining species belong to four families and include Chinese character *Cilix glaucata*, vapourer *Orgyia antiqua*, common footman *Eilema lurideolo*, garden tiger *Arctia caja*, white ermine *Spilosoma lubricipeda*, buff ermine *S. luteum* and ruby tiger *Phragmatobia fuliginosa*.

Finally, for Inner London P. C. Holland reports a male f. *carbonaria* of the peppered moth *Biston betularia* at Imperial College (27T68) on 20 May 1981, and Mr P. King records an imago of the old lady *Mormo maura* at Piccadilly on 19 July 1982.

V.C. 16, West Kent

Mr and Mrs Hall were fortunate enough to have a humming-bird hawk-moth *Macroglossum stellatarum* feeding on jasmine blossom in their garden in Chevening (45T86) on 10 July. It remained for several minutes, vanishing only when the camera was fetched!

At Hayes (36T86) I. F. Fryer saw an old lady *Mormo maura* on 14 July 1982, whilst at Dartford, during 1981, the first record of the beautiful snout *Hypena crassalis* for north-west Kent was obtained on 8 July. A few days later, on 13 July, a pinion-streaked snout *Schrankia costaestrigalis* was taken at the same locality; this is the first record for north-west Kent since the year 1910 (West 1981).

V.C. 17, Surrey

A death's-head hawk moth *Acherontia atropos* was discovered by Mr G. Messenbird on 7 September 1982 in Wandsworth (27T44) when he went to investigate the object which a group of children were cautiously poking with sticks. The unfortunate insect was rescued still alive by Mr Messenbird.

Mr P. King saw five-spot burnet *Zygaena trifolii* ssp. *palustrella* at Bookham Common (15T24 and 15T26) during 1981, and the same species was also present in that year at Box Hill (15T60). During 1982 Mr King saw several male ghost swifts *Hepialus humuli* engaged in their familiar hovering flight at the east end of Mitcham Common (26T86). Miss R. Davis has sent me a list of 32 moths recorded in Dulwich (37T22 and 37T42). These two tetrads contain private gardens, playing fields and a piece of woodland, and it is undoubtedly to this latter habitat that several of the moths reported owe their existence, for example the peach blossom *Thyatira batis* and the bird's wing *Dypterygia scabriuscula*. Other noteworthies on her list include the leopard *Zeuzera pyrina*, small emerald *Hemistola chrysoprasaria*, dark-barred twin-spot carpet *Xanthorhoe ferrugata*, light brocade *Lacanobia w-latinum*, and red-line quaker *Agrochola lota*.

Finally under the heading of V.C. 17 Mr P. C. Holland reports swallowtail moth *Ourapteryx sambucaria*, ingrailed clay *Diarsia mendica* and red underwing *Catocala nupta* from his garden in Clapham (27T84) during 1981.

V.C. 18, South Essex

From an urban garden at Wanstead (48T06), adjacent to the deciduous woodland of southern Epping Forest Mr C. Dale has sent me a list of 22 species taken at actinic light on one night during 1981. These include the clay triple-lines *Cyclophora linearia*, old lady *Mormo maura*, copper underwing *Amphipyra pyramidea*, and best of all, a Svensson's copper underwing *A. berbera*. Mr N. Nash brought to me several specimens he had taken at light during 1982. Among these were the shears *Hada nana* from Thorndon Park (69T00) and broken-barred carpet *Electrophaes corylata* and pale tussock *Dasychira pudibunda* from Navestock (59T46?). Amongst quite a lot from Havering Park (59T02) was the brown silver-line *Petrophora chlorosata*, silver-ground carpet *Xanthorhoe montanata* and a single dotted rustic *Rhyacia simulans*. At Rainham Marsh (57T28) he had the latticed heath *Semiothisa clathrata* and the cinnabar *Tyria jacobaeae*.

In the built up area of Walthamstow (38T68) Mr M. Dent had square-spot rustic *Xestia xanthographa*, large yellow underwing *Noctua pronuba* and marbled beauty *Cryphia domestica*, whilst further afield at Chigwell (49T22), Mrs G. Leader had the vapourer *Orgyia antiqua* and the knot grass *Acronicta rumicis* amongst others. Mrs D. Woods had a clouded border *Lomaspilis marginata* at Ilford (48T28) on 6 July 1981.

At the Epping Forest Conservation Centre (49T08) where a light trap was run weekly in the grounds during 1981, a female emporer *Saturnia pavonia* presented itself on 8 May of that year. The true origin of this insect however must remain dubious; it is almost certain to have been a released or escaped specimen. However, it may be worthy of note that during 1982 a workman for the London Borough of Redbridge found several larvae of this species in a ditch he was clearing at Barkingside (48T48) and brought one to me for identification. The Conservation Centre specimen was the first Epping Forest record for the present century.

At my own garden in East Ham (48T22) 183 species were taken at light from 1 May 1982, when I took up residence here, to the end of the year. Oak hook-tip *Drepana binaria* was the only representative of the Drepanidae, and came only in small numbers. Thirty-three species of geometrid included mullein wave *Scopula marginepunctata*, least wave *Idaea vulpinaria*, sandy carpet *Perizoma flavofasciata*, latticed heath *Semiothisa clathrata*, and fourteen pugs, including bordered

Euphithecia succentaureata, toadflax *E. linariata*, wormwood *E. absinthiata*, white-spotted *E. tripunctaria* and yarrow *E. millefoliata*. Amongst 485 moths in the trap on the night of 31 July-1 August were 33 extremely active garden tigers *Arctia caja*. The white satin *Leucoma salicis* came also on 31 July. The brown-tail *Euproctis chrysorrhoe* was common. Amongst the noctuids that I took during the year were the dog's-tooth *Laconobia suasa* during July and August, a single obscure wainscot *Mythimna obsoleta* on 13 July, a wormwood shark *Cucullia absinthii* on 10 July and a twin-spotted wainscot *Archanara geminipuncta* on 4 August.

To complete the review of South Essex, Mrs A. Brooks reports no less than four humming-bird hawks at Greenstead, Ongar (50T22) during the course of 1982.

V.C. 19, North Essex

No records have been received from this portion of the L.N.H.S. recording area for the period under review.

V.C. 20, Hertfordshire

Mr P. Waterton took a vestal *Rhodometra sacraria* and a tawny pinion *Lithophane semibrunnea* together in his trap at Welwyn (21T??) on 18 September 1982. The former species is a migrant, the latter a resident which can sometimes be seen at sallow *Salix* as early as March or April after hibernation. It more normally flies from September to November however, and although widely distributed does not appear to be common anywhere.

Mr J. King has also sent me a list of moths for this vice-county area, mainly based on observations in Potters Bar (20T60) and Essendon (20T68). At the former locality he includes in his list varied coronet *Hadena compta* chestnut *Conistra vaccinii* and snout *Hypena proboscidalis*. From Essendon he notes six-spot burnet *Zygaena filipendulae*, shaded broad bar *Scotopteryx chenopodiata* and cinnabar *Tyria jacobaeae* amongst other common species.

V.C. 21, Middlesex

Some of the best moths reported for the two-year period under review were trapped within this vice-county area. Mr A. M. George, Recorder for the Ruislip and District Natural History Society, found a single male balsam carpet *Xanthorhoe biriviata* in the ten-kilometre square TQ09 during 1982. The precise locality is withheld for the time being. This rare insect is known in Britain only from very few localities, having been first recorded as British in May 1955 (Minnion and Goodban, 1956). The larvae feed on *Impatiens*. Mr George also took a female seraphim *Lobophora halterata* at m.v. light on 15 May 1982. Although widely distributed in southern England the species is not common and is normally found only where the aspen *Populus tremulus* grows. This particular individual was taken at Pinner (19T00) some one-and-a-half kilometres from a known colony.

Mr George also kindly passed on the following records to me for inclusion here: Mr M. Hough and Mr M. Weaver took a single vestal *Rhodometra sacraria* on 26 September 1982, near Ickenham at 08T66. This was the first there since 1961 of this migrant species. Mr Hough also took the varied coronet *Hadena comta* at m.v. light on 22 June 1981 at Eastcote (18T06). This was only the fifth there since 1972. Finally, Mr George reports that W. E. Minnion had some good moths at Pinner (18T08). During 1981 a deep brown dart *Aporophyla lutulenta* presented itself at his trap on the night of 4-5 October, whilst a few weeks earlier, on 18 August, he had a yellow-barred brindle *Acasis viretata*, only the second there since 1967. In 1982 a humming-bird hawk *Macroglossum stellatarum* was present on 15 July — the last time it was recorded there being 1964. The oak lutestring *Cymatophorima diluta*, barred sallow *Xanthia aurago* and white satin *Leucoma* *salicis* were also noteworthy captures, but perhaps more important was the first ever capture there of Blair's shoulder-knot *Lithophane leautieri*, a species only fairly recently added to the list for the L.N.H.S. area, but one which is spreading.

Mr M. J. Hammerson has sent me a list of thirty or so moths from Highgate (28T88). These include small dusty wave *Idaea seriata*, dark marbled carpet *Chloroclysta citrata*, May highflier *Hydriomena impluviata*, small fan foot *Herminia nemoralis*, old lady *Mormo maura* and bordered pug *Euphithecia succentaureata*. From Hampstead Heath (28T66) he reports the five-spot burnet *Zygaena trifolii*, smoky wainscot *Mythimna impura*, burnished brass*Diachrysia chrysitis* and herald *Scoliopteryx libatrix*. The five-spot burnet was also seen near Brent Reservoir (28T06) by Mrs E. Chacksfield, who also reports vapourer *Orgyia antiqua*, buff ermine *Spilosoma luteum* and angle shades *Phlogophora meticulosa*, all quite common moths, from the same area. And finally for Middlesex, Mr M. J. Wells reports cinnabar *Tyria jacobaeae* and garden carpet *Xanthorhoe fluctuata* from near Feltham (17T00).

V.C. 24, Buckinghamshire

The only records received for this small portion of the L.N.H.S. recording area come via Mr A. M. George, who tells me that Mr M. Albertini, who runs a light trap near Chalfont (09T04), took specimens of the black rustic *Aporophyla nigra*, the orange sallow *Xanthia citrago* and the maple prominent *Ptilodontella cucullina* there during 1982. The last species has a distribution restricted principally to south-east England, mainly on chalky soils.

Acknowledgements

I am grateful to Mr I. G. Robertson, M.A., F.M.A., Curator for allowing the continued use of the Passmore Edwards Museum as a postal address for submission of records, and for allowing that address to appear here. I am also grateful to the office staff at the Museum for dealing with a large number of butterfly records which arrived there as a result of my various appeals.

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London Natural History Society
Statement of Affairs at 31 October 1982

1981				
		General Fund (formerly Premises and Equipment Fund) (incorporating the Hindson and Castell Bequests)		
82,672		Balance at 1 November 1981		87,825
	93	*Add:* Investment deposit interest	59	
	1,812	National Savings Bank interest	1,443	
	4,565	Investment income received	5,531	
	1,938	Income Tax recovered (including £1,303 for 1982/83)	3,397	
	1,692	Profits less losses on sales of investments	3,536	
	10,100		13,966	
	947	*Less:* Custodian's charges	1,225	
9,153				12,741
91,825				100,566
4,000		*Less:* Deficit for year		4,403
87,825				96,163
		Other Funds		
		Library Cataloguing Fund		
	99	Balance at 1 November 1981	99	
		Plant Mapping Scheme: Research and Publication Fund		
	212	Balance at 1 November 1981	212	
311				311
88.136				96,474
		Current Liabilities		
	2,900	*London Naturalist* provision	2,300	
	2,900	*London Bird Report* provision	2,200	
	—	*Programme* provision	400	
	945	Custodian's charges due	—	
6,745				4,900
£94,881				£101,374

1981				
		Assets		
		Quoted investments at cost		
79,670		(Market value £150,192)		86,890
		Funds at bank and on deposit		
		National Westminster Bank plc		
	347	Current account	754	
	2,500	Deposit account	750	
	408	Investment cash	143	
	11,862	National Savings Bank account	12,806	
15,117				14,453
94		**Cash in Hand**		31
£94,881				£101,374

Report of the Auditors to the Members of the London Natural History Society

We have audited the financial statements, comprising the above Statement of Affairs and attached receipts and payments account, in accordance with approved auditing standards.

In our opinion these statements give a true and fair view of the receipts and payments of the Society for the year ended 31 October 1982 and of its assets, current liabilities and fund balances at that date.

4 London Wall Buildings,
LONDON EC2M 5NT
1 December 1982

FRASER KEEN
Chartered Accountants

General Account for the year ended 31 October 1982

1981	1981	Payments		
346		Hire of halls, etc		1,153
546		Lecturers' fees and expenses, Sectional expenses, including L.N.C.C		532
7		Castell Research Centre		8
386		Library		381
43		Equipment repairs and renewals		143
341		*Bulletin* and *Newsletter* expenses		481
654		*Programme* printing costs		368
		Provisions —		
	—	*Programme* 1982/83	400	
	2,900	*London Naturalist* **61**	2,300	
	2,900	*London Bird Report* **46**	2,200	
5,800				4,900
1,134		Mailing costs (*L.N.* **60**, *L.B.R.* **45**, *Programmes*, *Bulletins* and *Newsletters* – postage, envelopes, etc.)		1,466
333		Cost of services (Auditors' fees, insurance, etc.)		393
650		Honoraria		625
116		Miscellaneous postage and telephone		88
26		Miscellaneous stationery		25
100		Contributions to other organisations		530
39		Sundries		1
£10,521				£11,094

1981	1981	Receipts			
	5,896	Subscriptions – current		5,825	
	—	arrears		6	
	158	in advance		121	
	64	entrance fees		61	
6,118					6,013
252		Donations			247
219		Tax recovered from deeds of covenant			257
224		Deposit Account interest			191
82		Sale of surplus library stock			52
429		Transfer from General Fund			—
		London Naturalist **60**			
	2,700	Provision 1981		2,900	
	(3,314)	Printing and expenses		(3,508)	
	(614)			(608)	
	25	Sale of offprints		34	
(589)					(574)
		London Bird Reports	Provision	Costs	
(450)		**43**	£2,100	£2,550	—
(25)		**44**	£2,700	£2,725	—
—		**45**	£2,900	£2,907	(7)
	690	Sales of journals		435	
	(94)	Expenses		(84)	
596					351
26		Subscriptions to *Bulletin*			43
		Symposium			
	232	Sales of tickets, etc			—
	(230)	*Less:* Hire of halls, fees, etc			—
2					
		Atlas of Breeding Birds of the London Area			
	43	Sales		—	
	23	Royalties		118	
66					118
3,571		Excess of payments over receipts (transferred to General Fund)			4,403
£10,521					£11,094

Book Review

Atlas of the Kent Flora. By Eric G. Philp. The Kent Field Club, Maidstone, Kent. 1982. 211 pp. £9.60

All serious naturalists in the London area should be aware of the excellent Kent Field Club, whose first major publication outside its own *Transactions* this is. Restive in the knowledge that Hanbury and Marshall's *Flora* of 1899 was the most recent account of vascular plants, and in some doubt that Francis Rose's long-promised work would ever appear in print, the Club decided to 'record every vascular plant to be found in every tetrad' in the county. A five-year programme having proved too ambitious, the ten years 1971-1980 became the final target. The result is the book now under review. The area covered is not perhaps what one might have hoped for, namely Watsonian vice-counties 15 and 16, but the 'present administrative county'; excluded therefore are the area controlled by the G.L.C. and a few small fragments on the border with Sussex. Since the former will soon be covered, with the rest of the L.N.H.S. area, by R. M. Burton, only Buckinghamshire of the Home Counties will be without a modern account of the flora.

Nine pages of introductory matter, including maps, method of survey, factors affecting the vegetation, and some statistics, are followed by a list of some 180 helpers and then by 188 pages of *Atlas* proper, arranged in two columns per page with the maps and related text appearing together in species order, a most convenient arrangement first used for county floras in Sussex (1980) and somewhat improved here. A list of 'lost' plants, a few references and a full plant index complete the book, together with two end-papers and nine other photographic illustrations of interesting habitats. The whole production is of excellent quality, between hard covers bearing an outstanding colour photograph of the late spider-orchid, on good paper. The plant maps – the essence of the book – stand out well, but my own preference is for the grid references to be shown rather than having to use the transparent overlay provided.

The order of classification and nomenclature are those of *Flora Europaea* with a few editorial amendments, e.g. the treatment of ferns, *Vicia sativa* L. and the cudweeds. Some keys are provided for the delimitation of certain taxa, e.g. *Salicornia.* Introduced species, of which there are very many, some of dubious merit, appear in the same format as that used for natives; use of smaller type or a condensed format would have indicated their minor importance while recognising that they were part of the flora during the survey.

Maps are presented for most native species. The main exceptions are rarities, when the localities are stated, but why no map of the 90 records of *Polygonum rurivagum*, so rare in all the surrounding counties? The 970 maps are very clear, and large enough to offer enthusiasts the possibility of keeping them up to date. Before each map is the scientific (Latin) name, with very little synonymy, and an English name mainly from the B.S.B.I. list. Synonymy can be a problem for anyone trying to compare atlas records with Hanbury and Marshall. A single example will suffice – on p.11 we find '*Oreopteris limbosperma* ....Lemon-scented Fern', which equates to '*Lastrea oreopteris* ....Sweet Mountain Fern' in H. and M. There is no help from the index. For each taxon there is a brief statement of status, habitat and other relevant information. Of 'critical' groups, *Rubus* as usual owes much to Alan Newton, *Rosa* to Dr Melville and *Taraxacum* to Dr Richards, though there has evidently been some enthusiastic collecting of dandelions. Other taxa such as hybrids and subspecies have been dealt with bravely but suffer as usual from a shortage of expert recorders. Unexpected records include *Asplenium septentrionale, Cerastium brachypetalum, Ulex gallii* and *Centaurium scilloides*. Conservation gets little mention, but I applaud Eric Philp's stern remarks on *Orchis simia.*

In an atlas like this, two aspects of frequency may be considered for each species: geographical, based precisely on the number of tetrads recorded, and plant density, i.e. the number of plants present, for which there will be little or no data from the survey unless preplanned. An attempt has been made to cover both aspects, and my only serious criticism of the *Atlas* concerns the multitude of undefined terms used for this purpose. These include abundant, common, frequent, local, occasional, uncommon, not common, far from common, scarce and rare, which may be modified by rather, locally, quite, fairly, very, etc. If one assumes (by normal definition) that 'local' is a geographical term, and should therefore refer to the tetrad count, how can the use of 'very local' for species recorded in from two to 63 tetrads and 'rather local' for six to 235 tetrads be justified? The reader will find many more examples. It seems to me that there is a need for a standardized frequency terminology; otherwise, authors must make their own meaning clear.

Of misprints, there is an embarrassing double for the benefactors Messrs Burroughs Wellcome, and the only county record for *Alchemilla xanthochlora* surely earned Mr Gorer a kinder fate. The plant names *Reynoutria sachalinensis* (p.22 and index), *Melilotus indica, Galium elongatum* (key, p.108) and *Muscari* (p.161 and index) are misspelt. The maps have occasional 'ghost' dots, e.g. p.11.

Despite these criticisms the *Atlas* is a great success for all concerned: the recorders, whose 265,511 records made it possible; the printers (Kent County Council, Supplies Department) who made such an excellent job of the production; and Eric Philp, whose hard work, knowledge and determination have produced a book which is a pleasure to use and essential for anyone interested in the Kent flora.

P. C. Hall

The London Naturalist

Instructions to contributors

Submission of papers

Papers relevant to the natural history and archaeology of the London Area should be submitted to the editor, Mr K. H. Hyatt, Department of Zoology, British Museum (Natural History), Cromwell Road, London SW7 5BD, before the end of January if they are to be considered for publication in the same year. They should be typed, with double spacing and wide (three cm) margins, on one side of the paper. Authors must retain a duplicate copy. Papers should include at the beginning an abstract, summary, or synopsis.

Text

Locality spellings should follow the latest editions of the maps published by the Ordnance Survey. Capitalization should be kept to a minimum. Common names of animals and plants must begin with lower-case initials, and scientific names must be underlined. When both common and Latin names are given there should be no brackets or commas separating them. Genus names should appear in full where first used within each paragraph. When scientific names are taken from a standard work, which must be cited, authorities should be omitted. In descriptive matter numbers under 10 should be in words, except in a strictly numerical context. Dates should follow the logical sequence of day, month, year (i.e. 25 December 1971). Measurements should be in metric and follow the SI system (Système International d'Unités), with imperial equivalents in parentheses where appropriate. There should be no full point following Dr, Mr, Mrs or St. Lists should be in natural, alphabetical or numerical order.

References

Reference citation should be based on the Madison rules (in *Bull. Torrey bot. Club* **22**: 130-132 (1895)), except that a colon should always precede a page number. Capitalization in titles of papers in journals should be kept to a minimum. Journal titles should follow the abbreviations in the *World List of Scientific Periodicals* and be underlined. Examples are as follows:

In text:

Meadows (1970 : 80) or (Meadows 1970).

In references:

MEADOWS, B. S. 1970. Observations on the return of fishes to a polluted tributary of the River Thames 1964-9. *Lond. Nat.* **49**: 76-81.

MELLANBY, K. 1970. *Pesticides and Pollution*. Ed. 2. Collins, London.

WHITE, K. G. 1959. Dimsdale Hall moat, part II. *Trans. a. Rep. N. Staffs. Fld Club* **92**: 39-45.

Illustrations

Distribution maps should be submitted in the form of a Recording Map with symbols in Indian ink or Letraset. Solid dots are used to indicate contemporary or recent presence, circles for old records and crosses (not pluses) for other information, such as introduced species. Tetrad dots and circles should be 4.0 mm and tetrad crosses 5.0 mm, with a line thickness of 0.8 mm; all monad symbols should be 1.6 mm with a line thickness 0.5 mm. The caption should be written outside the frame of the map and will be set up by the printer. The Mapping Schemes Secretary can provide Recording Maps, advice and dies for printing distribution symbols.

Line drawings should be in Indian ink on white card, larger than the printed size. Place names, etc., must be produced with stencils or Letraset. Captions should be separate as they will be set up by the printer.

Photographs should be glossy black-and-white prints, of good contrast, preferably half-plate in size.

Proofs

Galley proofs will be sent to authors for scrutiny, but only essential corrections can be made at that stage.

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